SPECIAL TENTH ANNIVERSARY ISSUE

OMNI

02484

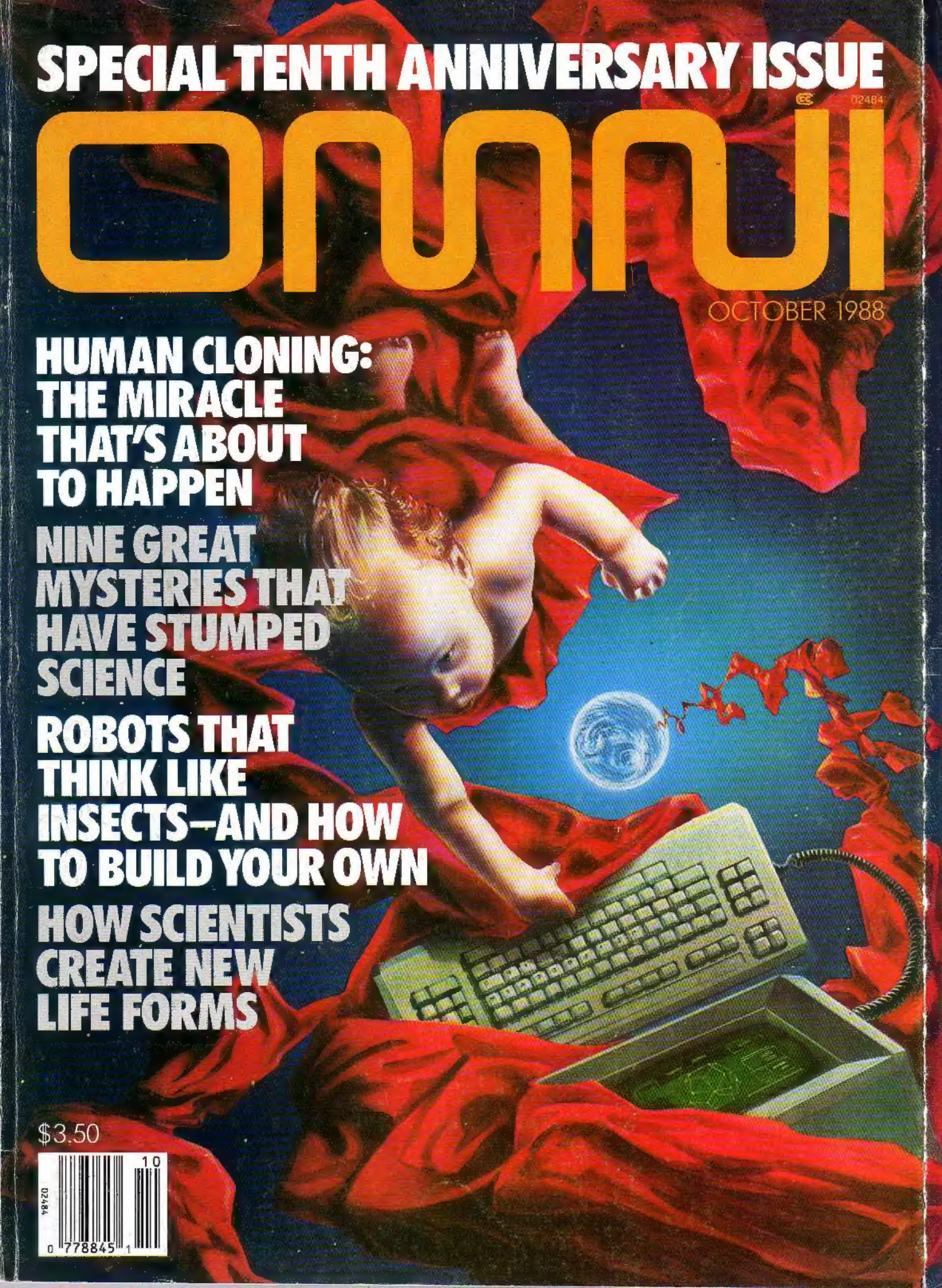
OCTOBER 1988

HUMAN CLONING: THE MIRACLE THAT'S ABOUT TO HAPPEN

NINE GREAT MYSTERIES THAT HAVE STUMPED SCIENCE

ROBOTS THAT THINK LIKE INSECTS—AND HOW TO BUILD YOUR OWN

HOW SCIENTISTS CREATE NEW LIFE FORMS



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Rendered in a renaissance mood, this month's cover is by Los Angeles artist Jean François Podevin, whose son William posed for the piece. Called The New Generation, *it was originally an ad for computer hardware.*

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FIRST WORD

By Bob Guccione and Kathy Keeton

"There is a universal architecture of infinite elegance and logic from which all things animate and inanimate seem to derive."

Ten years ago, founder/publisher Bob Guccione wrote OMNI's first "FIRST WORD," a declaration of hope and intent that pioneered a new era in science journalism. Other publishers, notably Time, Hearst, and even The New York Times, among them, encouraged by the young magazine's unique character and appeal, founded the clutch of competitors that kept us so high on our toes. But OMNI was special and today, with more than 5 million readers per month, its foreign editions in place or in the making, its books and newsletters, medical editions and audiotapes, television series and specials, OMNI has become the biggest selling and most widely read science magazine in the world. A fitting tribute to the man whose vision foretold the future and whose original manifesto we proudly reprint here. . . . Kathy Keeton

It was OMNI that I summoned up from the frost-cool morning of my youth. OMNI, born in the breathless dreams of that long-ago child. . . . It was much smaller then . . . a toy . . . the size of a matchbox . . . a flat, thumb-polished, silvery case bursting with exotic wires and tubes. . . . When I held it to my forehead, I could see the future.

Time may have transformed my OMNI, but its properties remain the same. . . . Its magic has become the alchemy of logic, the geometric progression of knowledge, science, and technology. . . . OMNI will continue to "see" the future . . . a future of growing intellectual vitality, of expanding dreams and infinite hope.

"The human mind," Albert Einstein once said, "is not capable of grasping the universe. We are like a little child," he continued, "entering a huge library. The walls are covered to the ceiling with books in many different tongues. The child knows that someone must have written these books. It does not know who or how. It does not understand the languages in which they are written. But the child notes a definite plan in the arrangement of the books—a mysterious order which it does not comprehend, but only dimly suspects."

Like Einstein's hapless child of humanity, I too am acutely aware of my failure to identify the Promethean nature and intent of these works. Their languages evade me, and I have little understanding of their internal order. But I am fascinated to behold them if only to speculate on their content, knowing that, collectively, they explain the mysterious forces that shape our destiny.

There is a universal architecture of infinite elegance and logic from which all things animate and inanimate seem to derive. There is continuity in the interflow of time and space . . . a harmony of intellect and invention between mind and matter . . . the world perceived and the world per se. . . .

All my life I have been fascinated with the sublime structure of Einstein's library and the variety and magnitude of its mysteries. I perceive a single key, however elusive, to its innumerable but interrelated disciplines—one key, a unique, master file in which each book is thoroughly identified, explained, and related to the whole. And one day (or so my natural optimism tells me) that key will be found. It already exists, in part, in every scientific and philosophical probe ever undertaken. It exists in every work of art, in every note of music, in the flight of a frightened bird, or in the odor of love.

My calling was art—the science of subjective vision. I was determined to reconstruct the world around me—to divine new disciplines . . . new relationships. My interest in the natural world, therefore, was singularly without limitation. Unlike most, I found art and science to be compatible. We appear to pursue the same goals—the absolute knowledge of our own special sense of reality; the *objective* reality of the scientist and the *subjective* reality of the artist.

OMNI, then, is my compromise—my way of bridging both levels of interest and inquiry. Like many of the more progressive ideas in our industry, OMNI evolved slowly, if not uneventfully, over a period of several years. I have created a few magazines in my time—conceptualizing and designing every aspect of each of them myself, but OMNI was different. It was a creation of pure joy—as if I were fulfilling the other half of that boyhood dream.

The idea of a science-related publication was not in itself new; science fiction was still a questionable art form struggling for status and recognition, and such matters as UFOs, ESP, and parapsychology received copious if not sensationalized coverage elsewhere in the media. Each of these ostensibly incompatible elements, however, had something crucial in common. Each represented (and contributed to) an ever-changing, sometimes indistinct, but always compelling frontier of intellectual and philosophical inquiry. This then is the editorial premise of OMNI—an original if not controversial mixture of science fact, fiction, fantasy, and the paranormal.

The "unknown" had become the subject of intense public interest. Institutional religion with its implacable dogma increasingly failed to satisfy our spiritual needs. Latter-day successes in science and technology began to expand our awareness of the unknown faster than the church could rationalize. We rose from an intractable position of simple, unquestioning faith to one of acute, cultural concern for truth and knowledge.

I designed OMNI in the shadow of this gathering storm—this inevitable and tragic collision between science and religion, between knowledge and faith. Man cannot shed one discipline without taking another in its place. The frontiers of human knowledge and experience are forever changing, forever expanding, and we, who are living at the very dawn of time, must make our common peace with change if we are to survive the next 1000 years.

CONTRIBUTORS

OMNIBUS

CHILD OF A LESSER GOD

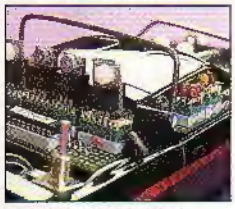
OATES

KAHN

A STAR IS REBORN

LEE COUNTY'S LIZARD MAN

IN A WORLD LIKE THIS



THE *OMNI* PHOTOVORE

If only I had a double, or if only I had four hands." Such murmurings, as well as much wailing and gnashing of teeth, were heard through the *Omni* halls this month. Putting together our biggest issue ever to celebrate our tenth anniversary has surely tested our devotion, ability, and sanity. We passed! But how much easier it would have been if we'd each had a clone.

This is not the wishful thinking of 20 years ago. Cloning a human is becoming increasingly realistic. The groundbreaking work with frog cloning was impressive but not as exciting as this year's cloning of cows and sheep. Mammals are certainly a quantum step closer to human beings.

Carol Kahn has coauthored, with Paul Segall, the soon-to-be-released book *Living Longer: Growing Younger*. Kahn, in her *Omni* feature "Double Takes" (page 58), tracks down and summarizes the research on human cloning. The story of mirrorlike biological replication is intricate, the ethical and political aspects are complicated, yet somehow Kahn managed to weave these components into a clear, concise, and thoroughly engrossing article.

Another group of scientists is introducing a whole new generation of artificial life forms. These innovators hope to combine the impulses of living organisms with the tools of computation to create new life from scratch. The process involves taking a noncarbon-based form like clay (among other inanimate substances) and endowing it with the ability to live, think, and reproduce. Contributor *Ed Regis* and associate editor *Tom Dworetzky* report on the progress and problems of this intriguing endeavor in "Child of a Lesser God" (page 92). (Maybe science will create a pet that doesn't need feeding or walking.)

A robotic "roach," on the other hand, has been developed at the Artificial Intelligence Lab at MIT. Can a puppy be far behind? Designed with a brain like an insect's, this robot, called the *Omni* photovore, is capable of several types of behavior. Senior editor Pamela Weintraub coordinated this project—the first of its kind—with the roach's creator, Jonathan Connell, and technical illustrator Jana Brenning. The best part is that the instructions to build your own photovore begin on page 201. The most sophisticated consumer robot available, it can be assembled for about $75.

The imagination can spawn an endless variety of new life forms. Contributing editor *Ellen Kunes* asked a number of celebrities how they would redesign themselves. In "A Star Is Reborn" (page 66) you can read what Tony Curtis, Malcolm Forbes, and John Cleese, among others, would change about themselves if given the chance.

Some of the *Omni* staff felt that a tan and perhaps eight consecutive hours of sleep would do the trick in their case.

This month you don't have to flip to the end of the magazine for the games to start. The House of Seagram's brings you eight brainteasers excerpted from *Omni*'s two books of games. Pull it out and keep it, because once you've figured out the answers, you'll want the booklet handy for the eight drink recipes.

And if you enjoy intellectual challenges, you'll love reading "Lee County's Lizard Man and Other Unsolved Mysteries" (page 106). *Dennis Stacy* and associate editor *Kevin McKinney* compiled nine special mysteries, ranging from the disappearance of Atlantis to the reappearance of the Lizard Man—South Carolina's version of Bigfoot. The tenth unexplained phenomenon could be one that you supply.

Fiction editor *Ellen Datlow*, who's responsible for a number of *Omni*'s awards, commissioned some exclusive fiction for our anniversary issue. In "Six Flights of Fantasy" (page 98) six famous authors, including *Joyce Carol Oates*, tested their powers of imagination. In a longer piece of fiction, "In a World Like This" by *Nancy Kress* (page 140), we see how easily our sense of reality can be threatened.

After ten years we're finally "perfect"—bound, that is. From now on, no more staples. And if we look as good as we read, it's thanks in great part to art director Dwayne Flinchum and his unflinching staff.

OMNI

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LETTERS

COMMUNICATIONS

Twenty-one-gun Salute

In her article ["Starship Enterprise," July 1988] Beth Karlin unashamedly reported the military backgrounds of George Koopman and Paul and Bruce Roth. In today's atmosphere of growing disdain for the military's involvement in scientific affairs, many writers would have been tempted to downplay or omit the military pasts of these three industrious pioneers. The idea of military involvement in space ventures is justifiably unpalatable to most scientists. Its contribution to our present knowledge of rocketry, however, is immeasurable and should not be forgotten.

John R. Gaines
Batesville, MS

He Who Labs Last

As a longtime *Omni* subscriber, I've never before had reason to write, though I truly enjoy every issue. But my enjoyment hit a snag with the July issue. Everything was fine until I reached Joe Fodor's supposed humor column [Last Word, July 1988]. Animals who suffer and die for mostly worthless and meaningless experiments should not be made light of—it's a crime against nature. I shan't cancel my subscription, but please don't print items of such poor taste again.

David Kveragas
Clarks Summit, PA

A Red Planet?

In your article "Of Mars and Men" [Space, July 1988] Isaac Asimov characterizes the struggle between Communism and democracy as a "petty difference." Count me out. I'm interested in space but not if it means tossing my principles out the window. I have lost interest in "lobbying" activities typified by the postcard mail-in campaign you endorsed in your "space issue." Face it: The Planetary Society would have us march arm in arm to Mars with the wardens of the Gulag—not an appealing prospect in my book.

Gary Dameron
Fairborn, OH

Who You Gonna Call?

Kudos to Tracy Cochran for "The Real Ghostbusters" [August 1988]. At a time when most writing about ghosts is either tabloid twaddle ("Does Elvis's ghost eat spectral bacon-and-peanut-butter sandwiches?") or small-minded "scientific" scoffing (why is the American Psychiatric Association phobic about ghosts, anyway?), her sensitive account of the men and women working on a shoestring and a prayer for truth comes as a breath of sweet, reasoned air.

Loren Eiferman
New York

I propose that psychology professor Charles Tart's suggestion—that computer-monitored electronic sensing devices and infrared photography be used to investigate hauntings—be applied instead to study those who claim to will out-of-body experiences. If psychic Ingo Swann would submit to tests during which he would command his own ghost-in-the-machine to exit his body and be present at the editorial offices of *Omni* while recorded on infrared film, the scientific community would be compelled to embrace the reality of paranormal forces.

Anthony Hans Klotz
Babylon, NY

"I" for Incomplete

If I were a teacher at Jerry Grey's metaphorical school ["Making the Grade," July 1988], I would say the Soviet Union has a recent history of steady space achievement with assignments turned in on time and extra-credit work. America's recent history, on the other hand, is that of a student who has conceived the idea of a mind-blowing multimedia term paper presentation but has failed to hand in the minimum required ten-page manuscript. Russia's average is the best in the class right now. Unfortunately for the United States, performance, not dreams, is the measure of success in school.

Steven E. Long
Felton, DE

PSYCHIC PSCORES

FORUM

By Sherry Baker

Back in October 1987, nearly 4,000 *Omni* readers closed their eyes, opened their minds, and attempted to see across time and space. They were participating in what parapsychologist Russell Targ calls the largest experiment ever conducted in which volunteers used psi to identify objects randomly chosen by a computer.

Targ, who heads the National ESP Laboratory in Portola Valley, California, designed the *Omni* psychic test that ran last October. He wanted to gather evidence of remote viewing—the ability to glimpse an object whose identity couldn't be known by any ordinary means or senses, only by extrasensory perception. For the experiment, interested readers were asked to pick a relaxed time and place, empty their minds, and ask themselves what their target object would look like (the items were held by psychic Hella Hammid). Any impressions or visions were to be written down or sketched. After resting for a minute, the test volunteers were to answer 21 yes-or-no descriptive questions about the object—"Is it shiny?" "Is its geometry mainly circular?" "Is it very dark?" and so on.

Because the participants were exposed to the same issue of *Omni* and, no doubt, to many of the same newspapers, TV shows, and more, the test had a built-in problem—how to make sure that the impressions people came up with were not simply the result of some shared stimuli. "We had to consider the stacking effect, a phenomenon that occurs when some common influence acts on a group of people and causes them to answer questions similarly," explains Jerry Solvin, parapsychologist and statistician at John F. Kennedy University. Solvin assisted in designing and analyzing the test. "For instance, say a star is the target in a remote viewing experiment, and an actual star has been in the news. But when people come up with 'star,' you don't know whether it's due to the news stories they've been hearing or to ESP."

To control the stacking effect, 500 *Omni* readers were chosen and given a different target from the main group.

To prevent anyone from leaking information about the identity of the target objects—a top hat for the main group and a French horn for the control group—the objects were picked by a computer only after *Omni*'s October issue had gone to press.

Among the readers who answered the invitation to test their psychic abilities was a woman who sensed that her target was metallic. More images flickered through her mind. The thing was shiny, she concluded, and it made a musical noise. After answering the questions, she wrote the object's identity across the questionnaire: a French horn.

She was absolutely right. "Several people in the main group said the object was a hat," notes Targ. "But that response wasn't specific enough to be considered a direct hit."

Targ is currently recruiting participants for other remote viewing experiments. For information write to the National ESP Laboratory, 80 Hayfields Road, Portola Valley, CA 94025.

The two target objects chosen for the Omni *remote viewing experiment were a top hat (main group) and a French horn (control group).*

MIRROR, MIRROR

STARS

By Ron Schultz

A telescope with the biggest mirror catches the faintest celestial rays—those that have traveled from the greatest distance and have taken the longest time to reach us. This is the light that started its trip near the beginning of our universe—the Big Bang.

The soon-to-be-largest such telescope, called the Keck, has now passed a critical juncture in its six-year construction schedule—the successful production of the first of the 36 separate pieces of its high-tech, multipart mirror.

As project scientist for the Keck observatory, however, Jerry Nelson has more than just an interest in the telescope's design and construction. His desires help to put the ultimate purpose of the mighty Keck into clear focus: "I want to look at the most distant galaxies in the universe," he says. He hopes to study those galaxies with the very high red-shift patterns that indicate they are the ones moving away from the earth fastest. "I want to know what the galaxies are like as we go further and further back in time. How those galaxies are distributed and how they have changed are critical questions. Their answers will have a substantial bearing on our theories of the evolution of the universe," Nelson says.

Personnel from Caltech and the University of California, under the auspices of the California Association for Research in Astronomy, are overseeing the Keck's creation. Their design aims to overcome the greatest enemy of large mirrors—gravity. These monstrous glass slabs can weigh tons. If they sag under their own weight, they become impossible to focus. No one has yet succeeded in building a structure able to rigidly support a one-piece mirror the size of the Keck's.

So the telescope builders turned to a multipart mirror design. Aligning all the different pieces of glass, however, is no simple task. To focus all 36 surfaces of the Keck's 14.2-ton reflector, a computer must adjust each segment of the honeycomb-shaped array every half second. To produce a perfect image, the system must provide alignment that is accurate to better than a millionth of an inch—about the distance spanned by ten atoms.

Potential difficulties also complicate the manufacture of the Keck's segments. An astronomical mirror usually has a single symmetrical, concave surface that enables it to focus light. The Keck's mirror, too, is symmetrical, but each of its segments has a specific nonsymmetrical contour, similar to that of a potato chip. Opticians at segment manufacturer Itek Optical Systems in Lexington, Massachusetts, must first polish the fronts and backs of the three-inch-thick glass discs, which are shaped like giant contact lenses. Using levers to bend a mirror's surface, they polish it to a smooth symmetrical shape. When they release the levers, the lens springs into the required nonsymmetrical configuration.

The job of producing just one of these segments would once have taken close to a year. Now with computer-aided stress polishing, it takes only three months. A device called a profilometer monitors the polishing process, telling the opticians when they have obtained the correct shape. Next the properly polished blank undergoes more precise testing at a three-story-tall facility that simulates conditions in the real telescope. The glass chip is cut into a hexagonal shape. Then craftsmen drill holes in the blank's underside and attach a portion of the mirror-support system. This reinforcement combines a disc that provides radial support; a post; and three flexible, multijointed pieces that branch out from a central point to form a spider-arm support—called a whiffletree. The term is actually a nineteenth-century word referring to the pivoting crosspiece that allowed draft animals in a team to move somewhat independently while pulling a wagon or carriage. The goal of this elaborate structure is to absorb any stress that might change the segment's surface.

The major kink in this mirror-building process is the uncertainty over how much the blanks will warp once they are

CONTINUED ON PAGE 217

The edge of night: With the Keck telescope, astronomers will peer farther than ever.

FOSSIL WARS

EXPLORATIONS

By Douglas Preston

Wanna buy a dinosaur? What's your fancy? An *Edmontosaurus* from Wyoming costs just $300,000, including delivery and assembly. Too much money? At $25,000, a saber-toothed cat from the Oligocene is modestly priced. If you'll settle for a souvenir from the Paleozoic, the nautilus-shaped goniatite cephalopod, just two bucks, is a steal.

Go to any gem and mineral show and you'll find all kinds of fossils for sale, many far from cheap. They're showing up in chic galleries with price tags more appropriate to the sculptures of Henry Moore than to the old bones of *Hyracodon*. Dinosaur fossils have even been found in Harrods, the London department store. The buyers come from all over the world, particularly Japan and West Germany, and range from museums wanting a big public attraction to businessmen looking for something to hang over their fireplaces.

To justify the exorbitant price tags, Peter Larson, one of this country's leading fossil dealers, explains that it takes 15,000 hours to dig up a dinosaur skeleton and then reconstruct it. "So we're really talking about twenty dollars an hour," he says. Since he sells most of his rare specimens to museums, Larson adds, he's careful to record such necessary scientific information as whether the bones are from one dinosaur or a composite of several; diagrams of bone placement are included as well.

While many paleontologists say that Larson is a responsible and careful operator, some disapprove of his work. Fossil dealers, they say, deplete dinosaur, fish, and other rare and often unusual bones. As a consequence, paleontologists are often unable to collect the bones for university and museum research. In a market where foreign museums and individuals are willing to buy fossils, American museums may be forced to pay high prices for fossils. "At three hundred thousand dollars per dinosaur, fossil dealers will put museums out of business," says Utah's state geologist David Gillette, now excavating the celebrated *Seismosaurus*.

In fact, with the growing value of fossils, even specimens already in museum collections are at risk. "Specimens obviously pinched from some museum's collection have turned up on the market," says Nicholas Hotton, head of the Smithsonian Institution's division of vertebrate paleontology. Museum employees and volunteers have often had access to bone storerooms. After a major theft a few years ago, the Smithsonian's directors increased security measures to protect the museum's vertebrate collection, placing many bones under lock and key.

"There are incredibly valuable specimens being sold overseas that American scientists may never have the chance to study," adds paleontological consultant Jim Madsen, a crusader against commercial fossil harvesting. "The harvesters trash quarries with indiscriminate digging, and they break the law. People who come out against them are threatened or ignored. It's as ugly as the drug trade, and you start worrying about your safety."

Bones of contention: Who'll exhume them?

Fossils have always been bones of contention, even among professionals. In the nineteenth century it was common for paleontologists to spy on one another, raid one another's quarries, and steal fossils. Today rumors about fossil thefts by scientists abound. The controversy between commercial harvesters and paleontologists, however, has added a whole new dimension.

In 1964 paleontologist Jim Jensen of Utah's Brigham Young University discovered the remains of the rare *Hypsilophodon*, the best specimen of the dinosaur ever found in North America. Having removed the fossil still embedded in its matrix, or stone encasement, he took it back to his lab, only to realize that part of the skeleton was missing. He returned to the dig site to retrieve the rest of the bones but found that harvesters had destroyed the site, digging up pieces of bone to slice, polish, and sell. "We may never find another *Hypsilophodon*, and we'll never know what it looked like," Jensen laments.

There's no single law, however, that governs fossil digging. Harvesting on private land, of course, is perfectly legal. And many Western states issue leases for digging on state-owned land, requiring the harvesters to turn over any bones of new or rare species. The problem is that harvesters don't always inform the government of unusual finds. As a consequence, Wyoming officials have begun offering rebates on license fees as an incentive to turn over valuable specimens.

It's almost impossible, however, to catch someone poaching fossils on federal land. In Wyoming, for example, the U.S. Bureau of Land Management (BLM) has only two agents responsible for its 18 million acres of land in the state. In addition to fossil poachers, they also have to deal with oil and gas thieves, illegally grazing animals, squatters, archaeological looters, and a host of other offenders.

Earlier this year the BLM agents apprehended two fossil harvesters

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THE PASTEUR SYNDROME

BODY

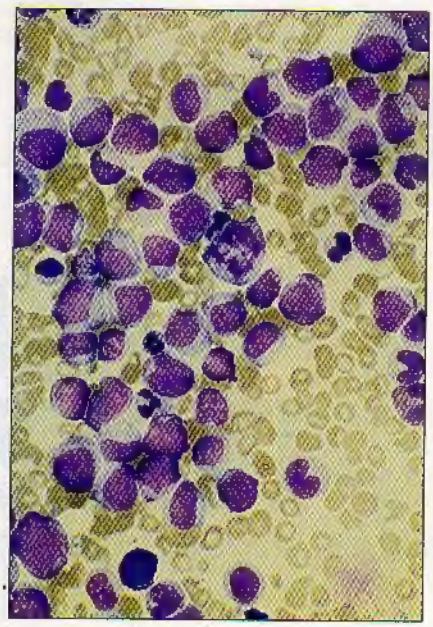
By Nancy Roosa

The questions began in 1985 when the first scientist from the molecular biology labs at the Pasteur Institute in Paris succumbed to cancer. Yves Malpiece, who had worked in one of the labs for just six months in 1980, was thirty-three when he died of Ewing's sarcoma, a form of bone cancer usually peculiar to children. Earlier that year, Françoise Kelly, a fifty-year-old senior researcher working with oncogenes—genes that have the potential to initiate cell growth typical of cancer—had been operated on for a malignant tumor. Some of the lab staff began to suspect that there might be a connection between these two cancers and two cases of non-Hodgkin's lymphoma found in 1981 and 1983 in a pair of thirty-five-year-old researchers who'd worked in the same labs. By the end of the year, a fifth cancer had been diagnosed among the workers—this time a rhabdomyosarcoma, or muscle tumor, in a thirty-six-year-old man. And there was to be a sixth case of cancer among the ranks—yet another case of non-Hodgkin's lymphoma, which would be diagnosed and reported by the patient, a thirty-six-year-old man, in May 1987.

Initially slow to respond to the situation, institute officials finally ordered two investigations—one internal and the other international—to determine what link, if any, might account for the cluster of cancers. The results of the internal investigation are due to be made public next year. In the meantime, Pasteur spokesmen have refused to release the names and prognoses of the four researchers still living and won't even describe the precise nature of the work being done in the two labs. We do know that all six researchers used radioactive materials and recombinant DNA and that one ongoing project called for testing industrial products, which spokesmen won't identify by name, for their ability to cause cancer. Several of the institute's researchers told the journal *Science* that pressure to fulfill commercial contracts for testing new chemical compounds for their capacity to induce genetic mutations could possibly have led to relaxed safety standards in the labs.

When Malpiece died in 1985 Kelly still did not believe that the staff's cancers were related to her work. A number of her colleagues, however, disagreed and persuaded the lab directors—Maurice Hofnung and Pierre Tiollais—to request an inquiry. In March 1986 Tiollais wrote a letter to institute director Raymond Dedonder, demanding an inquiry. Dedonder refused. By April of that year Kelly, who would be dead within the month, began concurring with the prevailing wisdom in the labs: The cancers *were* connected and *were* related to the work being done. She confided in Lazare Goldzahl, a nuclear physicist. She also changed her will, adding a codicil in which she asked for an investigation.

Intrigued, Goldzahl conducted a preliminary inquiry, canvassing cancer specialists around the world. The results convinced him that the cancers could not possibly be coincidental, and he wrote to François Jacob, the institute's president, urging him to reevaluate Dedonder's decision. At the end of April, the institute directors announced that a ten-member commission headed by Professor Jean Bernard, president of the French Academy of Sciences, would conduct an investigation.



Cell break: Escape of the cancer genes?

Kelly died on May 4. Three days later, Dedonder sent a terse memo to his staff, calling for an immediate reinforcement of security measures in the labs. He ordered all unit chiefs to "reestablish the classical measures of protection" and to "establish a protocol for the utilization of mutagenic substances."

Initially, Dedonder's memo did not cause much of a stir. His staff was to reread it with greater care on June 5, when the weekly newsmagazine *L'Événement du Jeudi* broke the story of the Pasteur cancers to the public.

Later that day, institute spokesperson Dr. Caroline Chaine made a brief statement, but she disclosed little specific information. Chaine identified the two dead scientists as "A" and "B," described a total of only three cancer cases, and refused to specify the types of cancer that had been suffered. She chose instead to stress that the scientists' research was unrelated to their cancers. "All three of them were checked regularly by doctors at work, and no evidence of a professionally related disease was discovered," Chaine said.

Le Monde, France's daily newspaper, featured the story in its front-page headlines for the next two days, June 6 and 7. The paper identified Malpiece and Kelly by name and described both their work and their cancers. Staff reporters interviewed a number of Pasteur researchers, who criticized the directors. "It would be maddening," said one worker, "if in this temple of triumphant science they did not seek to understand what has happened." *Le Monde* also reminded readers of a similar incident at a genetic institute in Orsay, a suburb of Paris, where three lab workers were diagnosed as having

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STARLIGHT EXPRESS

SPACE

By Bill Lawren

The dream has been with us since the dawn of manned flight: to escape the limits of our own solar system, cross the yawning reaches of space, and explore the stars. So far that dream has been constrained by the awful distances involved—our nearest stellar neighbor, Alpha Centauri, is 25.5 *trillion* miles away—and by our inability to build a rocket fast enough to traverse those distances in a reasonable time. (An Apollo-type Saturn 5 rocket traveling at 25,000 miles per hour would take about a billion years to reach Alpha Centauri.)

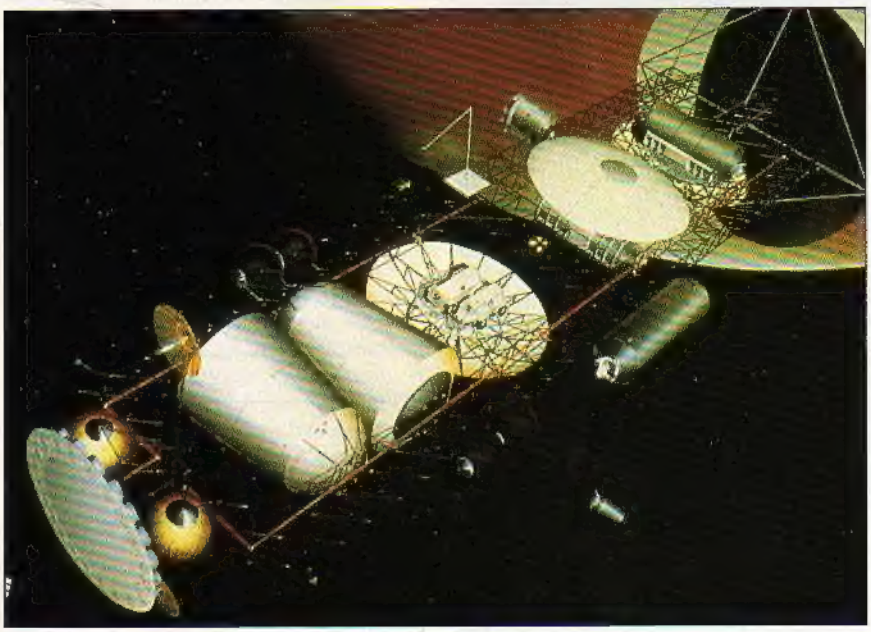
There have been plenty of proposals for breakthrough rocket designs to reach the stars. The trouble has been that they have all depended on technologies that won't exist in any but the longest-term future—until now.

Enter George Chapline, a theoretical physicist at Lawrence Livermore National Laboratory in Livermore, California. For the last year Chapline has been working part-time on plans for an interstellar craft that would be powered by what amounts to a sort of nuclear waste: the subatomic fragments produced when atoms are split apart during nuclear fission reactions. Once harnessed and propelled out the back of a rocket, this "fission fragment" fuel, Chapline maintains, could generate rocket velocities of up to 18,600 miles per second (10 percent of the speed of light), making it possible to reach Alpha Centauri in only 50 to 100 years. Furthermore, Chapline says, a prototype of this vehicle could be built for a reasonable amount of money—perhaps as little as $50 million—with existing technology. In fact, he contends, for an unmanned interstellar observation mission the fission fragment rocket is "far and away the most practical idea that's ever been proposed."

Chapline began thinking about an interstellar spacecraft some ten years ago. It was a basic law of physics, he knew, that the speed of a spacecraft depended on the velocity of its exhaust; the action of the exiting exhaust gases would simply cause the rocket to move in the opposite direction at equal speed. Thus a vehicle capable of interstellar travel would have to be thrust forward by an exhaust almost approaching the speed of light. He also knew that during fission, atoms fly apart at speeds of about 7,400 miles per second. If properly harnessed, he figured, those fragments could propel a spacecraft at up to one twentieth the speed of light. Thus, according to Chapline's calculations, a fission fragment rocket could theoretically deliver a 500-pound payload to Alpha Centauri in about 100 years.

The central problem lay in devising a system that would capture fission fragments from a nuclear fuel and direct them out the back end of a rocket to provide the necessary thrust. Over the next several years Chapline devoted much of his spare time to designing just such a system. The result, published this year, has at its heart a radically new design for an onboard nuclear reactor. The reactor would contain almost microscopically thin fibers coated with nuclear fuel—either curium 245 or americium 242. Surrounding the fuel would be "moderator" material made of carbon 13 plus deuterium in the form of some organic material such as heavy wax. The moderator would control the rate of the nuclear reaction by modulating the rate at which neutrons hit the mass of fuel. Once the reaction "heated up," millions of atoms would break apart, their fragments escaping at high speeds from the surface of the fibers. A magnetic field generated by the rocket's motors would gather the fragments and channel them out the back of the rocket to provide thrust.

The efficiency with which the motor directs fragments is crucial: To reach Alpha Centauri in 100 years, for instance, the motor must be about 70 percent efficient. "Right now," Chapline says, "it would be relatively easy to build a prototype fission fragment rocket with, say, fifty percent efficiency." If fueled by cheaper uranium or plutonium, such a rocket, which he estimates would cost up to $100 million, could generate



Gone fission: Nuclear propulsion may drive the first earth ship to Alpha Centauri.

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DARK HEARTS

MIND

By Paul Bagne

He sounded forth a trumpet of warning and alarm," eulogized a friend at his funeral. "He sensed the sinister nature of the menace: Communists infiltrating our institutions and subverting men's minds." Senator Joseph McCarthy passed on in 1957, in the prime of life, lips silenced, said his devotees, by vindictive foes who censured him, crushed his spirit, and ruined his health. Actually, if psychological factors did contribute to the many ailments that ultimately took the demagogue's life at forty-eight, it's more likely that McCarthy's own character—a cynical, mistrusting, and suspicious nature—killed him.

"One aspect of hostility is particularly predictive of bad health in general," reports Redford Williams, an internist with the psychiatry department of Duke University Medical Center in Durham, North Carolina. "That is the cynical mistrust of human nature and motives. This is a person who suspects that others are not trustworthy, who experiences more anger and copes with it by expressing or suppressing it."

For ten years Williams has searched for the toxic component in Type A behavior, a mishmash of attitudes including ambition, urgency, hostility, and impatience. A decade ago studies indicated that Type As were at twice the risk of heart disease. Williams's research, however, has suggested that only anger, hostility, and cynicism are true risk factors. He cites two of his studies which show death rates to be four to seven times higher among people with hostile attitudes. Long-term research on thousands of subjects is needed to confirm early findings, but it appears that hostility may be as bad for the heart as high cholesterol or elevated blood pressure.

To test whether the mistrustful die younger of all causes, not just heart disease, the Duke researchers took advantage of a project started in the Sixties at the university's Aging Center. Then investigators gave 500 middle-aged and older people a variety of physical and psychological tests and have followed the health of these subjects.

Among the tests given was a personality analysis developed at the University of Illinois, Urbana, by renowned psychologist Raymond Cattell, founder and director of Honolulu's Cattell Research Institute, who set down 16 factors he thought accurately assessed personality. He invented names for each. Factor L is "protension," meaning "inner tension projected outward." Most might call it suspicion. Like the others, factor L is scored on a bipolar scale from 1 for a trusting nature to 10 for high suspiciousness.

"McCarthy's way of projecting suspicions onto other people illustrates high factor L," says William Lohss, a psychologist with the Institute for Personality and Ability Testing in Champaign, Illinois. "But his level of suspicion was so exaggerated it was almost pathological." Political writers described the senator as shrewd, dispassionate, and calm as he pursued the elusive Reds he loathed. "He is an engine of outward fury operating in an inner mode," wrote William S. White in *The New York Times*.

Some of McCarthy's personality traits may also explain why his factor L took on the hostile form it did, says Lohss. "Fury is not a necessary element. In fact, some high factor L people can project their tensions through creativity in arts and sciences." He adds: "People scoring low on factor L tend to be accepting, tolerant, and adaptable, perhaps naive. Those scoring high tend to be irritable, aggressive, critical, and dogmatic. They do not forget criticism and are bothered by what others say behind their backs. It's not as if these people are paranoids," says John Barefoot, a Duke psychologist. "It's just that some are less trustful than others."

Barefoot participated in the 500-person Duke study matching personality traits to mortality. After factoring out smoking, cholesterol, alcohol intake, and other health risks, the Duke team concluded that those scoring very high on factor L when the study began in 1969 were at 40 percent greater risk of

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Cardiac alert: A suspicious and cynical nature may render you prone to a heart attack

MIT'S ROACH MOTEL

ARTIFICIAL INTELLIGENCE

By Fred Hapgood

If you or were ass gned the job of des gn ng a robot vacuum c eaner we wou d probab y be at a loss when t came to f gur ng out how to get t to clean corners Rodney Brooks has come up with a so ution, however wh ch s one of the reasons he s d rector of the mob e-robots group at MIT's Artificial ntell gence Laboratory

If your robot looked ke a contemporary vacuum cleaner," Brooks points out, t would probab y be too arge to get into the corners To do that you might need a second sma er robot It could be about two inches in d ameter and an inch th ck, w th s x legs sticking out of t Once t had dragged itself across the floor and used its egs to determine when it had reached a wa or corner it could start p ck ng up dirt and shoving it nto ts be y

Brooks has the g ft of laying out the solution to a problem in as much deta as if he were describing an a ready existing real ty And, in fact in Brooks's lab small s x egged robots already exist

For the past four years, he has been des gn ng nsect ke robots that adapt to d rt, no se, chaos and confus on He has given them a battery of sk s that w l enable them to negot ate a sorts of terra n—w de open spaces t ny open ngs, rooms w th ots of obstacles He even knows what to do with the dirt a small vacuumbot ingests

It could go to some centra location and get rid of the dirt there" he expla ns "But that means having extremely good navigation abi t es and a deta ed map of the house A better plan would be for it to use sound sensors to sten for the b g vacuum cleaner When it heard the mach ne, t wou d run to the m dd e of the room and dump ts guts, leaving the mess for the big guy to cart away

Such s the future," Brooks says sm l ng broad y

Historically he says the machines bu t by robot cs researchers have been limited in their ability to dea with the real world Some researchers have overcome this prob em by prov ding their mach nes with simple environments featur ng unref ect ve and unadorned wa s, high y controlled and standard zed l um nation, and uniform corners But usua y the mach nes have broken down anyway The world it seems a ways manages to seep n

Brooks is confron ng the prob em head-on by bu d ng robots whose function is to wander around and nteract w th humans and other robots n the real world, which n this case means the work spaces and offices of his group This is a landscape of old p zza cartons camera tripods, b cyc es ref ect ve surfaces (chrome egs, m rrors glass) rock-climbing boots, piles of soda cans circu t boards sk poles nests of wir ng and stacks of computer pr ntouts It is a wor d in wh ch students stride down ha s wh le reading a book in which doors fly open w thout warning To be tru y mob e here means be ng able to maneuver in and out of e evators and up and down stairs

Bu ding robots that can ve in such a var ed env ronment has ed Brooks to a new ph osophy of robot construct on, one cur ent y attracting considerab e nterest in robot cs c rcles around the world His goal a mach ne that s as capab e as an insect of negot at ng the world a machine that can traverse a sorts of terrain with the f nesse—if not the speed—of a cockroach That, he expla ns is why h s laboratory is ca ed (informa y) the artificial insect lab

"Classically robots and A programs are bu t with a single processor running a sing e program," he says "Such a system is inherently frag e one g tch anywhere and the whole enterprise dies" Instead, Brooks s bu d ng robots with a host of genera skills that run simu taneously and independently There is no s ng e oc us of contro , no centra map of the environs

The enormous advantage of this approach is that each skill can be des gned separately, debugged and man pulated without crash ng the whole Similarly if one of these sk ls or

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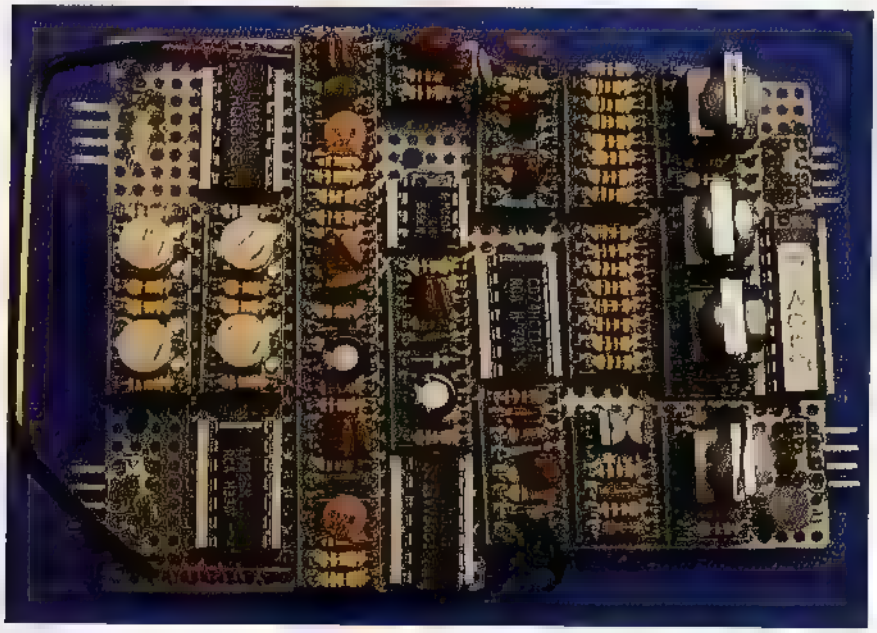

Rodney Brooks s robots crawl on six legs and have circuit boards (above) for brains

AMAZON APOTHECARY

EARTH

By Sy Montgomery

Arriving at an Amazon village as a doctorate student in the late Seventies, Michael Balick was greeted by a wrinkled old woman and a group of Bora Indian shamans who were laughing uproariously. He asked his bilingual guide what the woman had said. The translation: "Too bad this guy didn't arrive a few years ago when we still ate people. He would have fed the entire community."

Now a decade later, Balick and a team of field biologists from New York's Botanical Garden are working with tribal villagers to scour the Amazon Basin for a different kind of fare: the next generation of anticancer drugs.

Hoping that the search will yield plants with some anticancer activity, the National Cancer Institute has awarded a five-year contract to the Bronx organization to collect specimens from the rapidly disappearing jungle. So far only 1 to 5 percent of the Amazon's 80,000 plant species have been studied.

"The rain forest is a veritable chemical factory," says Balick, an ethnobiologist and acting director of the garden's new Institute of Economic Botany.

In fact, many important modern drugs have come from plants. Penicillin hails from a mold; cortisone is derived from yams, and the muscle relaxant tubocurarine from curare, an extract from an Amazon vine used by Indians for arrow poison. Atropine, a drug for stomach ulcers, comes from the belladonna plant; the tranquilizer and high blood pressure drug reserpine from Indian snakeroot; and codeine from the opium poppy of the East.

A powerful cancer breakthrough took place in the Fifties, when the rosy periwinkle yielded the first truly effective drug for fighting childhood leukemia. Locals in Madagascar had used an extract of the plant for lowering diabetics' blood sugar levels. When studied in American labs as an insulin substitute, it was completely ineffective. But scientists found that it dramatically reduced white blood cell counts, actually bringing about remissions in 85 percent of childhood leukemia cases.

In the depths of the jungle, a plethora of cancer remedies lie waiting

In their quest for other potent cancer drugs, biologists from the botanical garden will collect 1,500 bulk samples from 500 to 700 plants each year. The researchers can limit their search thanks to tribal medicine men, who help by directing scientists to plants *they* use in their own pharmacopoeias.

Once collected, the plants will be shipped to the garden's herbarium in New York and to the institute's labs in Maryland, where an improved form of analysis will light the way. Traditionally researchers studied chemicals by watching their effects on mice with a single form of animal leukemia. In a quicker and more selective screening process, which the institute is now developing, extracts will be tested against up to 100 different strains of human cancers growing in test tubes. In addition, all the extracts collected will be kept frozen for possible reexamination by researchers working to develop new anticancer screens.

"Nature contains a lot of novel and unusual molecules that the chemist at the bench may not have ever discovered," says Gordon Cragg, a scientist with the natural products branch of the National Cancer Institute. The institute is so enthusiastic about this approach—in fact, that the $2.6 million overall grant for the program includes contracts with the Missouri Botanical Garden, now collecting plants in tropical areas of Africa, and the University of Illinois in Chicago, currently seeking plants in the jungles of Southeast Asia.

But if laboratory scientists are acquiring a new reverence for tropical plant life, it is not one shared by loggers, farmers, miners, and cattlemen working in tropical countries themselves. Balick points out that thanks to those people, rain forests worldwide are being destroyed at a rate of many millions of acres per year. As this land disappears, the cultures with which it is linked will vanish as well.

"We have at most twenty years to do this inventory," says Balick, before the rain forest—and its rich pharmacopoeias—is virtually destroyed.

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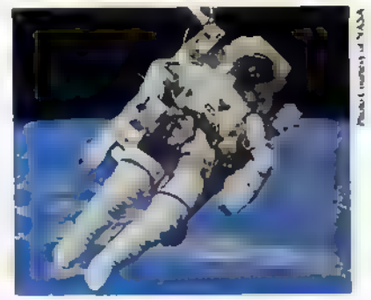

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CAPTAINS OF VIDEO

ARTS

By Kevin McKinney

Every day for hours at a time I would see an eerie light coming through the crack of the doorway and hear strange sounds emanating from Joe's room, says Mary Nissenson, a former news reporter and anchor for the Chicago television station WBBM.

Convinced that her stepson was devoting too much time to his video games, she gave him her "culture spiel" to encourage him to expand his mind. At his urging, however, she agreed to let him show her why he was so wrapped up in the games. "His next complaint was that I was hogging his system," says Nissenson, now president of Foresight Communications, her own television production company.

Like a growing number of adults, Nissenson has become not only a video game player but a Nintendo Entertainment System (NES) expert. "I've come out of the closet," Nissenson openly admits. "Much to my parents' dismay while they're reading Dostoyevski, I'm busy plodding through *The Legend of Zelda*. And they gave me the same culture spiel I gave Joe."

A recent survey by the newsletter *Computer Entertainment* indicates that 76 percent of its 12,000 subscribers own *at least* one video game system. Most of the models are the NES. This closely depicts the video game market in general. Nintendo of America controls nearly 80 percent of video game sales, with Sega and Atari sharing the rest. (None of the systems are compatible.)

According to Nintendo's own surveys, 30 percent of video game players are older than eighteen. Product analysis manager Howard Phillips adds that about 20 percent of those who call Nintendo's game counselors are adults requesting game play advice—for themselves, not for their children.

"For someone who thinks he has a pulse on what's going on, I was surprised by how many adults are into video games," says Brett Stover, an executive producer for cable television's Financial News Network (FNN). "Every college educated adult I introduce to Nintendo goes crazy for it. I know a guy from IBM who has the system wired into a wide screen television that hangs from the ceiling, and the full stereo system is plugged into it."

Nintendo parties, moreover, are becoming the hot new wave of social interaction, sort of like Trivial Pursuit was," Stover adds. "Six or eight people get together, set up several video game systems, and have them going at the same time. They go on for hours and get pretty out of hand."

Most often playing Nintendo's *Super Mario Brothers*, which puts workmen Mario and Luigi against supernatural bad guys, the partygoers will play one-on-one and team against team, Stover explains. When someone approaches a new level of the game that no one else has reached, however, a camaraderie takes over as everyone cheers on the individual player. The parties are similar to the 250 Nintendo "Fun Clubs" organized by kids around the country.

"When video games first came out, they were simply considered toys and not something that adults would get involved with," says Phillips, who began as a Nintendo warehouse manager but preferred playing the games to unpacking them. (Now he gets paid to play them.) "Now that young adults who played them in the early Eighties are maturing, video games seem to be breaking into adults' awareness."

But even adults who didn't play them when they were younger are discovering that today's video games are very sophisticated. Expanded memory chips coupled with the same kind of microprocessor found in Apple IIc and Commodore 64 personal computers, the systems are advanced computers dedicated to playing video game cartridges that are computer programs.

The NES, for example, can handle 64 times more data than earlier systems. The graphics are more dazzling, the colors (as many as 52 on the screen at a time) are more effective, and the sound more realistic.

Indeed, the Consumer Electronics

CONTINUED ON PAGE 216

Not for kids only. Adults find today's video games sport sophisticated software and graphics.

CONTINUUM

THE CLONING OF AMERICA

A McDonald's hamburger is the same in Los Angeles, Miami and Branson, Missouri. So are Kentucky Fried Chicken and Pizza Hut pizza. New housing developments in all parts of the nation build the same house over and over again, shifting only the angle of the home or the position of the garage for distinction. And then there are the movies: *Alien, Aliens, Rocky I, Rocky II, Rocky III, Rocky IV*. America, it seems, has become a country of repetition, of clones from sea to shining sea.

The virtues of industrial uniformity—reliability, predictability, and standardization—have been recognized since Eli Whitney first manufactured interchangeable parts. In nature, with many plant and animal species consisting of exact genetic copies of one individual, this sort of uniformity has been going on for millions of years. By reproducing clonally (sans sex), species wind up with generation after generation of the same genetic individual. The biological machinery needed for an organism to reproduce asexually, in fact, seems to evolve quite easily. As with a movie, once the characters have been created and the general theme decided upon, it's easy to make a sequel.

In sexual reproduction, on the other hand, each offspring is a novel entity with a genetic code of its own. But sex is a hassle. Beyond the obvious problem of finding a mate, only half of each participant's genes get passed along to the next generation. The clonal individual, which passes on all its genes, would appear to have a distinct advantage. Yet sexual reproduction is the rule, not the exception. What, one might ask, does nature know that American culture doesn't?

For one thing, species that reproduce sexually can incorporate beneficial mutations more rapidly than those that keep putting out copies of themselves. If a good mutation appears in each of two different clonal lines, it will remain isolated. Among the sexually reproductive, however, two individuals bearing two different traits need only mate to begin spreading the traits through the population. In the same way, if one chain of bookstores follows one formula for selling books, and another chain follows another formula, then good ideas will not spread easily from one franchise to another. The situation is obviously much worse when all chains follow the same formula. Sexual reproduction creates the best environment for the spread of good genes because, like bookstores that don't follow a formula, it increases the chances of new and more adaptive traits (or ideas) getting into the system.

Diversity is also minimized by clonal reproduction. A species that clonally reproduces is just one large, fragmented individual and can hold only a minimal amount of genetic information. New species arise much less frequently among these organisms than in sexual populations. In fact, most nonsexual species are of relatively recent origin and may not survive the slow march of evolutionary time. They may simply not have the capability to adapt to environmental changes. Similarly, cultural clones may be slow to adapt to changing tastes, as may a religion, philosophy, or political party that finds ideological security in a narrow and rigid dogma. All may be headed for extinction in a changing world.

Sex may also have a number of short-term advantages that speak to social as well as biological issues. Since each individual is unique, a predator or disease that has cracked the defenses of one member of the species will not necessarily destroy *all* the individuals or the group as a whole. Each member of a clonal line, on the other hand, will be at risk from a common predator or disease because each organism is genetically the same. Agricultural geneticists found this out the hard way in the early Seventies. A leaf blight in the South devastated thousands of acres all planted with the same strain of corn.

America, it seems, has much to learn from evolutionary biology. Problem solving depends on creative and novel solutions. When we find refuge in established modes of thought, we run the risk of becoming inflexible, clonelike creatures. Although trends toward repetition and duplication are attractive because they are cheap and easy, they are superficial solutions that ignore the complexity of our ever-changing world. We need to cultivate an eye for deeper answers that come from unexpected places. We need a blending of ideas and a constant stream of creativity—from artists, poets, authors, and even scientists who think about sex. This may be our best defense against an unpredictable future. *–NORMAN C. ELLSTRAND*

Norman C. Ellstrand is a professor of botany and plant sciences at the University of California, Berkeley.

CONTINUUM

The last place on Earth has suddenly gotten very crowded. With hungry tourists searching for new camera fodder, scientists in Antarctica have been forced to take action.

Not so long ago, Antarctica was considered one of the remotest places on Earth, populated only by penguins and the few intrepid scientists who found it fertile if frozen, ground for research. Now, however, the peace and purity of both Antarctica and the science conducted there are being threatened by what may be the most dangerous of all animals: the thrill-starved tourist.

Last year, reports Guy Guthridge of the National Science Foundation (NSF), cruise ships and chartered planes delivered as many as 3,500 visitors to Antarctica's icy beaches. The tourists tramped through seabird rookeries, snapped zillions of penguin photos, even descended on the South Pole itself. Even more bothersome to the scientists was the tourists' tendency to pop in uninvited at research stations, taking up scientists' time and disrupting ongoing experiments, most particularly those that were studying the effects of isolation on humans. In fact, one report estimated that these unsolicited visits ultimately resulted in the loss of as many as 40 research days. "It used to be a delight when there were only two to three visits a year," says Guthridge. "Now there's a real danger that the research stations here will be swamped."

So what to do? The NSF plans to organize more orderly tours so that their effect on science will be minimized. That way, says Guthridge, "the tourists can see the installation quickly and then go away."

—Bill Lawren

The new science of gene-splicing has already given us giant mice, frost-resistant corn, and sheep that look like goats. Now a Canadian scientist reports what may be the most unlikely bioengineering product to date: square trees.

It started ten years ago when Robert Falls, now of the University of British Columbia in Vancouver (UBC), was working as an environmental biologist in Canadian forests. After seeing the disastrous results of clear cutting, "it came to me," he says, "that there had to be a better way to make wood." His ingenious solution was a "designer tree" with a square trunk, so that significantly less of its lumber would be wasted in milling. As a graduate student, Falls concentrated on the cambium, the layer of cells just under a tree's bark that manufactures new wood. Ultimately, by using still

Yes, Virginia, there are square trees . . . in Canada.

secret bioengineering techniques he was able to play a game of geometry with the cambium by manipulating cell production rates. The results, now growing on experimental UBC plots, are cedar and poplar trees whose trunks, if not precisely square are decidedly squarish.'

A dedicated environmentalist Falls thinks his work could someday have considerable impact on the world's forests. 'This is a way of taking some of the pressure off natural forests,' he concludes. 'Instead of taking what we can from natural systems we'll be able to design systems that produce what we want.' —Bill Lawren

"Intelligence has a lot to do with what folks believe. Those with smart kids, for example, are more likely to believe in heredity."

—Frank Clark

"He who laughs has not yet heard the bad news."

Bertolt Brecht

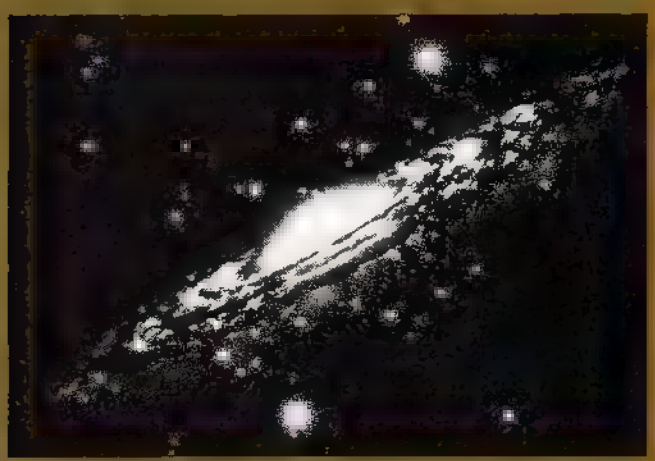
There may be more out there in space than emptiness. That seemingly endless vacuum may actually be a sea of energy. "It's like a strange fluid that's everywhere," says cosmologist Joshua Frieman of the Stanford Linear Accelerator Center. "It's not tangible in any way. The only thing we can feel is its gravitational effects."

It appears that the early universe went through a series of dramatic transitions, starting out hot, then gradually cooling and expanding. In the process, vast amounts of energy were generated, consumed, and released.

It's almost certain, says Frieman, that when the cooling was done, much of this energy still permeated space. But it couldn't have lingered at that intensity for long. "Vacuum energy has negative pressure; it forces matter apart," he explains. "If a huge amount were around, the universe would blow up very rapidly. Things like galaxies could never even have formed."

So Frieman and several colleagues are studying the possibility that the vacuum energy has been gradually diminishing since the Big Bang. It's not yet known why. But if it's true—if some amount of this energy has been at work throughout time—it would significantly alter our understanding of the evolution of the universe.

—Amy Mereson



There's more to space than meets the eye. A new theory suggests the vast vacuum may actually be filled with energy.

For almost 300 years the stringed instruments of Antonio Stradivari have been prized by musicians for their uniquely pure and powerful tones. But what accounts for that sweet sound? One investigator thinks that a microscopic water fungus in the lumber used for the instruments holds the secret. (See "Stradivari's Secret," Continuum, February 1987.) And now a team of scientists at England's Cambridge University has found another factor—a layer of special volcanic ash applied to the surface of the wood.

Peter Edwards and his colleagues subjected fragments of an eighteenth-century Stradivarius cello to analysis by a technique called EDAX (energy dispersive X-ray spectroscopy), in which a compound is bombarded by high-energy electrons, then analyzed to identify each ingredient. The EDAX "profile" of the Strad showed a thin layer between the wood and the varnish that was identical to a material called pozzolana, a volcanic ash from the Italian district of Cremona where Stradivari lived and worked.

Interestingly, pozzolana has been used for centuries to make a high-quality and extremely durable cement. In fact, Edwards speculates that Stradivari used the material primarily to make his instruments last longer and that the Strads' remarkable tonal qualities may have been merely an unintentional by-product.

Does this mean the blooming of a new generation of latter-day Strads? "We've had quite a few calls from instrument makers," Edwards says. "But I doubt that anyone can turn out a Stradivarius just by using pozzolana."

—Bill Lawren

What becomes a legend most? Even Stradivari didn't know.

CONTINUUM

SOIL SAVER

The images of the devastating dust bowl of the Thirties, with topsoil swirling in violent clouds and bankrupt farmers trekking to California, seemed all too familiar this past summer. Farmers in drought-ridden areas of the Midwest feared their fields might be blown away once again, which is one reason Jim Germida's latest research may turn out to be timely as well as valuable.

Germida, a soil scientist at the University of Saskatchewan in Canada, knew that soil erosion can sometimes be reduced by certain natural microorganisms that serve to bind soil particles to one another and keep them from being blown away by wind. Were there man-made compounds, he wondered, that could be even more effective at gluing soils down? He began testing commercial products used to prevent soil erosion on slopes and eventually discovered one that did the job both in a laboratory wind tunnel and outside in an open field. Studies also indicate that the compound won't contaminate the soil. Furthermore, it may even be biodegradable.

Despite its promise, Germida refuses to reveal the name of the product for fear of engendering false hopes. "I know people are desperate with all the drought in farming areas," he says. "But it's too soon, and the product itself is very expensive. It would be impossible to use, even over a small field." He's now experimenting with applying the product only to a field's most erosion-prone "hot spots." Germida is also testing various diluting ratios that would make the substance cheaper to use. In the meantime, he does pass along one tantalizing hint: "The product that works best," he says, "is white and pastelike. In fact, it looks a lot like Elmer's glue."

—Bill Lawren

The dust bowl exodus. Will an experimental glue developed at the University of Saskatchewan keep topsoil from blowing in the wind?

"It is not true that life is one damn thing after another; it's one damn thing over and over."

—Edna St. Vincent Millay

"If people think nature is their friend, then they sure don't need an enemy."

—Kurt Vonnegut

"It is of interest to note that while some dolphins are reported to have learned English—up to fifty words used in correct context—no human being has been reported to have learned dolphinese."

—Carl Sagan

TANK-O-SCOPE

Just before the space shuttle enters orbit, its huge orange external fuel tank is jettisoned from the craft and tumbles back down to Earth. Although wasteful, safety and necessity left NASA little choice about what to do with the tank until now. A new plan being evaluated by the space agency would enable NASA to recycle the fuel tank, transforming it into an orbiting gamma-ray telescope.

The tank-to-telescope project reflects an effort by NASA to develop new uses for costly space hardware. "This application would be a first step toward finding new uses for these tanks," says Max Nein, study manager for the telescope project at NASA's Marshall Space Flight Center.

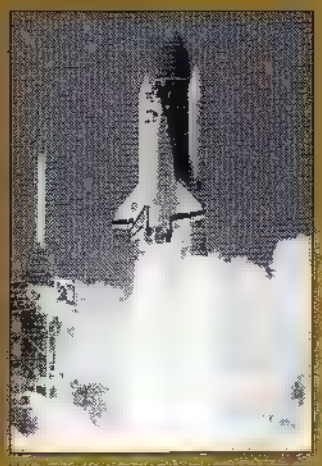
To create the telescope, astronauts would work on the empty tank in Earth orbit, converting the lower half, a 95-foot-long section used for storing hydrogen fuel, into the housing for the telescope. Because the tank's access hatch is only 36 inches wide, the astronauts would insert a collapsible mirror through the small opening and then inflate it with air. Nein explains that the tank would be filled with a gas, such as CO_2, that would emit a flash of light when struck by a gamma ray passing through the tank wall. The mirror would reflect these light flashes onto detecting equipment.

Astronauts in space suits have demonstrated the feasibility of the plan by attaching an inflatable mirror to a fuel-tank-base mock-up in Marshall's neutral buoyancy simulator, a 40-foot-deep water tank that simulates microgravity conditions. Nein says that if funded, the conversion could be performed by the late Nineties.

—Oliver Fultz

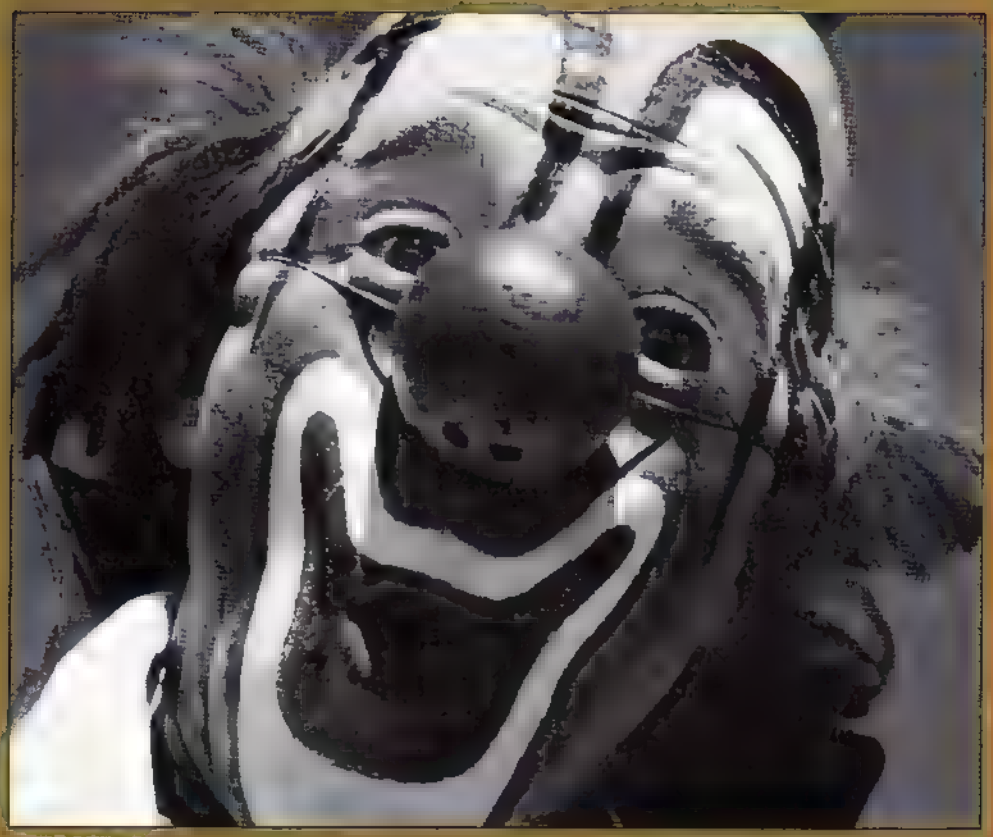
"A great many open minds should be closed for repairs."

Toledo Blade



Why waste a fuel tank when you can turn it into a telescope?

CONTINUUM



Sometimes it takes a Bozo to deal with bozos, or so two Cincinnati police officers say. Dubbed the "Dork Squad," they help to defuse tense situations by clowning around.

It's an age-old scam. One guy distracts your attention while another grabs your wallet or purse. But this time, the perpetrators aren't asking for directions, they're goofing off. And they're not bad guys, they're cops.

Cincinnati police specialist Michael Gardner and his partner Michael Broering, dubbed the "Dork Squad" by fellow officers, use humor to distract angered people and defuse dangerous situations. They have been known to button their uniforms askew to make suspects laugh, rearrange furniture during a domestic squabble, and pretend to be pizza delivery boys. "It's the ridiculousness of the situation that makes suspects say, 'Hey, these cops are crazy,'" says Gardner.

The cops picked up their unorthodox methods from psychoneurolinguistics, a discipline that combines communication theory with linguistics and psychology. One of the fathers of psychoneurolinguistics and director of the Phobia Institute in West Los Angeles, psychologist Donald Dossey, says that Gardner and Broering's technique works well in police work. "They interrupt patterns with an incongruity to get someone's attention and pull them out of a disruptive pattern," he explains.

Gardner, a 15-year veteran of the Cincinnati Police Department, is currently teaching his slapstick psychology at the police academy. And though his course will never replace traditional police training, a little hard-hitting humor may occasionally be a cop's best weapon.—Bob Mangino

Scientists at Los Alamos National Laboratory have developed a drill that can bore through rock in the waterless airless vacuum of space. It may one day be used to build an underground American base on the moon.

The drill, originally designed for use on Earth, uses special metal tips that heat up, melting the rock. Unlike regular drills, the Los Alamos model would not need air or water to remove the cuttings and cool the bits, meaning it would work well in space. Plus, as the drilled moon rock melted, it would get pushed into the pores around the drill hole and cool into glass, eliminating the need for supports to hold the hole open.

Why bother drilling through moon rock when we could set up a lunar base on the moon's surface? The radiation environment is too extreme, says James Blacic, a scientist at the lab. An on-the-surface moon base, for example, space station modules protected by some sort of covering, would work only in the short run, he says. Once you start talking about a permanent or long-term moon base with a few hundred people, however, you have to dig. "Ultimately," says Blacic, "we'll have to go underground on the moon."—Devera Pine

"Men become more civilized, not in proportion to their willingness to believe, but in proportion to their readiness to doubt."

—H. L. Mencken

ELECTRIC NOSE

We should have smelled it coming. After all, we've seen bionic limbs and artificial hearts. Could a prosthetic nose be far behind? Chemists from Sandia National Laboratory in Livermore, California, and Albuquerque New Mexico, report a development that may lead to the world's first artificial nose.

Bob Bastasz, Bob Hughes, and their colleagues at Livermore were looking for a way to "sniff out" hydrogen atoms, which are emitted from gas plasmas used in some experimental fusion reactors. They knew that an element called palladium can act as a sort of hydrogen filter, allowing only small hydrogen atoms to pass through it. So they built a sensing device the size of a pencil eraser that included a palladium "screen." Once the hydrogen atoms pass through the palladium, they strike a series of electronic diodes, thus registering the presence of hydrogen gas.

For the moment, the nose's only application is in monitoring hydrogen emissions from experimental fusion plasma reactor cores. But, Bastasz explains, the device could, in principle at least, be used to detect anything that contains hydrogen.

Other researchers are looking for palladium equivalents that can sniff out elements and compounds other than hydrogen. If and when those materials are found, Bastasz speculates, they might be used in artificial noses that could detect gas from leaking stoves or even odors from spoiled food. "We're getting into science fiction here," he says, "but you might even be able to design a wristwatch-size device that would tell you the level of a pollutant in the atmosphere."—Bill Lawren

"There is much pleasure to be gained from useless knowledge."

Bertrand Russell

It's no Jimmy Durante, but it may lead to an artificial nose.

ROBOTS IN SPACE

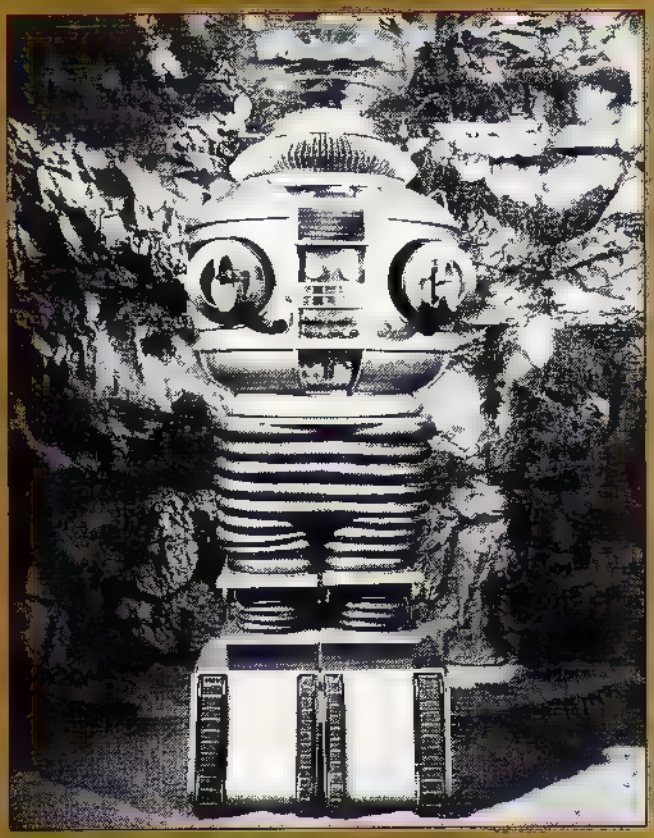
Remember the goofy-looking robot in *Lost in Space* that screamed "Danger! Danger!" and flapped its arms every time Dr. Smith embarked on yet another ill-starred adventure? Good. Now, forget that image. The robots on NASA's space station won't be anything like that robot.

To start with, they won't even resemble a typical robot. They'll have only one arm—with seven "joints" to it—and a video camera for "eyes." And they won't have free run of the station, either. Instead, they'll run on tracks on the walls.

As for their jobs, the first robots on the space station will be used to keep scientific experiments running when there are no astronauts onboard, says Byron Purves, a manager for Boeing.

Once the station is fully manned, robots will pitch in with the cooking and cleaning. A robot will make dinner by reading cooking instructions from a bar code on a food package. It will then set the microwave oven. "We'll probably have the robot poke buttons [on the microwave], since people have to be able to use the microwave, too," says Purves. "We don't want only the robots to be able to prepare food—we don't want to be totally dependent on them." Other tasks suitable for a robot include changing air filters and washing walls.

Purves expects the robots to save time and money. Because it will cost about $20,000 an hour to fly an astronaut on the space station, the less often that astronaut has to wash windows, the better.—Devera Pine



With only one arm each, robots on the space station won't look anything like their television counterpart from Lost in Space.

CONTINUUM

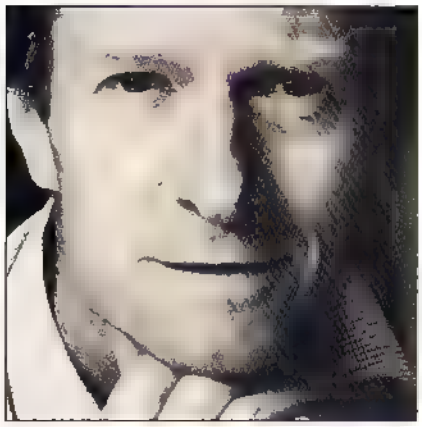
ARTICLE

Advances in reproductive technology have opened the door to true immortality: the living, breathing, thinking, yearning clone

BY CAROL KAHN

DOUBLETAKES

"We might engender a community of "clonants" who share not only physical traits but a common way of thinking."



In the late Seventies and early Eighties a middle-aged man with the money to fund impossible dreams began haunting the laboratories of a small, select scientific fraternity. Its members were the men and women capable of performing nuclear transfer—a painstaking procedure in which the nucleus of a cell in the body is used to "seed" an egg. The technique is better known as cloning, the making of a biological double.

Although cloning had been carried out successfully only in frogs, the man—call him Adam, though that's not his real name—hoped it could be adapted to humans. His goal: nothing less than immortality. Specifically, Adam was looking for someone to create a "body clone," an individual identical to himself in every respect save one. It would lack a brain. The idea, advanced by University of California, Los Angeles researcher Paul Segall, was that the cells destined to become the brain would be removed from the clone very early in embryonic life. As for the rest of the clone, grown to an appropriate size and maintained in frozen storage, it would be there when it was needed. As Adam's body was damaged by disease, injury, or advancing age, the body clone could be harvested for its parts—heart, lungs, liver, kidneys, skin, muscles, bones, blood—all fully transplantable, with no possibility of rejection. This first body clone could serve as the source for a second and then a third. Cloning would be the ultimate fountain of youth, a bottomless well from which Adam could drink again and again.

But apparently Adam's fascination with genetic Xeroxing went beyond a brainless stand-in. One cloner recalls the day Adam came into her lab, threw his money up in the air, and spoke of supporting her research. Later, Adam, who was by all accounts highly intelligent and personable, came to her house for tea, there he spoke of his interest in transferring the information from his brain to the brain of a clone. "He wanted another him," she says, her eyes widening at the thought.

Today some of Adam's dreams are based on scientific fact. *The New York Times* started its readers this past February, for instance, when it ran a front-page picture of three black Brangus cattle as alike as three proverbial peas in a pod. Two other mammalian species—rabbits and sheep—have been cloned. And at least four companies are in a race to bring genetically duplicated animals to the marketplace. Indeed, plans for cloned herds (where quality would always be consistent) are already in the works. "The era of cloning has arrived," says Jim Robl of the University of Massachusetts, a major player in the race. "It's the next and perhaps the final step in genetic improvements in animals."

Cloned cows and sheep may have ranchers buzzing. But could the age-old dream of *human* cloning ever take place? In fact, recent startling accomplishments suggest that the cloning of people may soon be here. A few researchers are investigating the possibility of using cloned embryo parts to repair damaged hearts, brains, and lungs. Others hope they will soon be able to grow cloned body parts in laboratory dishes, just as they now grow sheets of skin. And in an astounding technical feat, cloners have begun to ac-

Previous pages: Fertility renegade Landrum Shettles. This page, clockwise from left: UCLA cryonics expert Paul Segall, Cambridge University's John Gurdon, and Audrey Muggleton-Harris of the Medical Research Council in Surrey, England.

DODGE DAYTONA TURBO Z. Its power can be used to stretch the mind to limitless new heights, connected to reality by a 5-speed Getrag gearset. Its reactions to commands are supremely quick, thanks to a performance-tuned suspension and vented disc brakes at every corner. It comes with our exclusive 7 year or 70,000 mile Protection Plan,* and driver air-bag restraints. And with bold, all-new ground effects styling and an aerodynamically honed shape, it is nothing short of electrifying. The 1989 Dodge Daytona Shelby. Designed for total performance. Body. And soul.

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tivate dormant genes in a variety of cells, their work has important implications for slowing the aging process and regenerating limbs. But it is also a crucial step in cloning a new individual from the highly specialized cells of an adult. Finally, recent techniques for in vitro fertilization, or test tube babies, provide the means by which clones can be transferred from the lab dish to the uterus, where they can be carried to term. Indeed Landrum B. Shettles, the controversial fertility pioneer, insists that we may be able to clone a human *today*. All it would take, he says, are the right set of cells, which he claims he has identified, and a lab. As Adam found out on his quest, most experts agree that human cloning is a lot closer than was thought just a few years ago.

Once human cloning is a reality, will people be bred like cattle? Will asexual reproduction replace the most delightful means of having a baby? And even if the technology is available, should we avail ourselves of it?

Whatever the final answer to these questions, there is no doubt that human cloning has long exerted a pull on the imagination. Who among us does not gawk at identical twins as though they were a tourist attraction?

Literature has treated us to a barrage of clones. In Aldous Huxley's *Brave New World*, the Hatchery and Conditioning Centers mass-produced human models like cars on an assembly line. Ira Levin's *The Boys From Brazil* featured 94 Hitler clones from which the notorious Josef Mengele hoped to create the new führer. Cloning even became front-page news when science writer David Rorvik claimed in his book *In His Image* that an unidentified millionaire had bankrolled unnamed scientists to create an undocumented clone.

Although almost no scientists supported Rorvik's claim, many believe that cloning would open a cornucopia of biological options undreamed of by Mother Nature. A couple at risk of passing on an inherited disorder, for instance, could clone the unaffected partner. Infertile men or women who used their own body cells to create a child would give the term single parenthood a whole new meaning. And a childless couple could each be cloned for posterity.

As Nobel prize-winner Joshua Lederberg has said, cloning "places man on the brink of a major evolutionary perturbation." We could duplicate people with genetic traits like night vision or the ability to hear high-pitched sounds. We might engender a community of "clonants" who share not only physical traits but a common way of thinking, leading to an almost mystical mingling of minds. "In a stretch of imagination," says Joseph Fletcher, a bioethicist at the University of Virginia, "a lone biologist could carry a sampling of cells to a distant planet and colonize it."

Despite the dazzling potential, however, creating genetic carbon copies was the last thing on the minds of the cloning pioneers. Instead, these researchers were interested in solving a conundrum raised in 1892 by German evolutionary theorist August Weismann.

As Weismann observed, there are two kinds of cells in the body—the germ (the sperm cells and the egg cells, which produce the next generation) and the soma (the cells of the blood, brain, muscles, and everything else).

Each somatic cell has two sets of chromosomes in its nucleus. When it divides into two cells, all the chromosomes double, and each daughter cell receives a complete double set. But when the eggs and sperm are formed by a process called meiosis, the two sets of chromosomes are broken up, and only one set goes to each of the daughter cells. Each egg cell and each sperm cell carry a random mix of half of an individual's traits. The only time they have a complete set of chromosomes is when their nuclei come together during fertilization. At the moment of fertilization, life begins anew with an individual that is identical to neither its mother nor its father but rather is a 50–50 combination of both.

Starting out as a single cell, the embryo grows rapidly, not in size but in number of cells—first two cells, then four cells, then eight, then sixteen, and so on. Soon the embryo is a mulberrylike cluster of cells called a morula, scarcely bigger than the fertilized egg. As division continues, the morula turns into a hollow mass called a blastula (blastocyst in mammals), which is first hundreds, then thousands of cells strong.

Early in division, all the cells of the embryo are indistinguishable from one another. But later some of the cells begin to specialize, and the process of differentiation begins. As development proceeds and the embryo takes on shape and form, more and more cells become committed to a particular pathway, changing in form and function. The blood cells make hemoglobin, the muscle cells make a muscle protein, and so on.

It's obvious that cells in the differentiated state express only *some* of the genes present in the original, fertilized egg. Weismann wanted to know what happened to the genes in the differentiated cells as the embryo developed. Were they lost as the cells took on their specific functions, as Weismann believed? That is, did intestinal cells lose the genes to make hemoglobin? And did nerve cells lose the genes to make muscle fiber? Or did the specialized cells retain all the genes, even the ones they no longer used, like a grown-up holding on to toys that are no longer played with?

If the latter case were true, then a single cell from, say, a nose or heart or eye had everything it needed to produce a new individual. There were some early attempts to unravel this mystery. But re-

searchers were in the dark until a dramatic 1952 experiment conducted at the Institute for Cancer Research in Philadelphia lit the way.

One of the scientists who took part in that early study was Marie DiBerardino today a professor of physiology at the Medical College of Pennsylvania. Visit her lab and you'll find it filled with dozens of frogs at all stages of development. Some are tadpoles no bigger than an inkblot with a tail, others have hind legs, still others have begun growing their forelimbs. There are frogs as small as a thimble and others large enough for French dining. Some are produced by natural means and others have been produced by the hands of Marie DiBerardino herself.

The DiBerardino of today, a petite woman with cropped gray hair, a quick smile, and a keen eye, bears a striking resemblance to the pretty, long-haired brunet in a 30-year old picture adorning the laboratory wall. The DiBerardino in the picture is smiling as she stands next to Robert Briggs, who died in 1983, and Thomas King, now deputy director of the Lombardi Cancer Institute at Georgetown University. As DiBerardino tells it, the trio got its start when Briggs gave her her first job out of college as a research assistant in his Philadelphia lab. Soon after that he brought in King, who had just gotten his Ph.D.

Briggs wanted the answer to the Weismann riddle, and the way to do it seemed obvious. Empty an egg cell, put in the nucleus of a somatic cell, and see what happens. If you could produce a complete animal in this way, then the genes of the somatic cell were still there. If you couldn't get normal development, however, then most likely something had happened to those genes.

To do his experiment, Briggs would use the species for which he was already known in the field of embryology—*Rana pipiens*, the leopard frog named for the spots on its back.

He gave the job to King, who, after endless hours of trial and error, finally came up with the nuclear transfer technique that's still the basis of cloning today. Peering through a microscope with dials and joysticks to allow precision control, the cloner sucks up an isolated cell into a hollow glass pipette. The opening of the pipette, which must be hand forged to the exact thinness, is just wide enough to break the cell wall but leave the nucleus intact. Using the pipette the researcher removes the nucleus from the somatic cell and injects it into the egg cell, whose chromosomes have been removed. So difficult is the technique that even today few are skilled at it.

DiBerardino still remembers the day in February 1952 when she walked in to work to find Tom King dancing down the corridor. Pulling her into his lab, he pointed triumphantly to his microscope.

He had been trying to get a clone to reach the first major stage of embryonic development, a complete blastula. But each time some of the 7000 to 8000 cells making up the hollow ball had failed to divide properly. Now she looked down to see a perfectly formed basketball-like sphere with bumps and ridges on the surface indicating that the cells had fully cleaved. Hearing the excitement in the laboratory another colleague wandered in. King handed the newcomer a pair of forceps with which to turn the blastula and see that its cells had succeeded in dividing all the way around.

"This person—I won't use the name or gender—looked, was duly impressed and left," says DiBerardino. "Then Tom sat down to look at his blastula and found the person had *squashed it* and walked away without saying a word. We all slapped him on the back and said 'If it's real, you'll do it again.'"

It was real, and that year Briggs and King published their historic paper on the first successful cloning of a multicellular animal, a tadpole. But the Weismann question of what happened to the genes of somatic cells was still unresolved. The cells used to make tadpoles had come from early embryos that had not yet started down the path of differentiation.

"One cloner recalls the day Adam came to her lab, threw his money in the air, and spoke of funding her research. He wanted to transfer the information in his brain to the brain of a clone."

The Philadelphia team went on to perform a series of experiments using cells from progressively later and later stages of development. They found that with each stage of development, the number of tadpoles and frogs they were able to clone dropped dramatically. Finally when they took cells from a very late stage of embryonic development in which the tail begins to appear, they were not able to clone a single tadpole. As the organism matured, the group concluded, the genes had somehow changed.

Meanwhile, across the Atlantic at Oxford University a graduate student with a mop of sandy blond hair and a dreamy, Hamlet quality decided to see if he could answer the Weismann question for himself. Instead of using the leopard frog, however, John Gurdon decided to try his luck with a different amphibian—the pointy-toed South African clawed toad.

Like Briggs and King, Gurdon began the nuclear transfer experiments by using cells first from the early embryo and then from later stages of development. Finally he took cells from the intestine of a tadpole; these intestinal cells were fully differentiated, as could be seen by their brush border, a highly indented surface that allows the cell to absorb food for the hungry growing animal.

Using these cells Gurdon was able to get a tiny percentage of the clones to become adult sexually mature frogs. A few of these even went on to bear young themselves, showing that they had gone through the entire life cycle and that they were normal in every respect.

When he published a paper in 1962 there was an immediate flap. Here was a young graduate student telling the team that pioneered cloning that they had somehow gotten it wrong. "My work indicated that the genes were *not* altered when the cell differentiated," Gurdon says. "My interpretation was opposite the one posed by King and Briggs."

But Gurdon had yet to reach the grail of cloning a fully functioning adult animal cloned from an adult cell. (Although the cells he used were fully differentiated they had come from a tadpole.) In 1975 he finally cloned an adult frog using its skin cells and got normal tadpoles. Although two of his tadpoles actually underwent metamorphosis, turning into frogs, they never did reach adulthood. The prize has eluded Gurdon to this day.

Why didn't these normal tadpoles turn into adults? Gurdon doesn't know for sure. But today, talking from his office at Cambridge University, where microscopes and lab dishes range along the wall and his desk holds a small collection of rubber frogs, he says he has an idea. Adult differentiated cells and egg cells, he explains, are on two very different timetables for division. The egg is on the fast track, ready to spring into action about an hour after fertilization, while the far slower differentiated cells programmed to divide every two days or longer. So when the nucleus of an adult cell is placed in a recipient egg, it is forced to divide before it's ready. Chromosomes get left behind or are torn apart. The result is that some of the clones have chromosomal abnormalities and may be genetic "monsters." And, Gurdon says, errors in the chromosomes may prevent the frog from completing development.

Gurdon has tried to get around this problem by doing serial transplants, in which nuclei from the cells of a clone in an early embryonic stage are used to start a new clone. This can be done over and over again, each time selecting cells from the embryos that show the most normal development. It is this "selection of the fittest" that Gurdon believes, allowed him to end up with the two tadpoles that almost made it to adulthood.

"By transplanting a reasonably large number we found that we did get a few that had almost everything the parent cell had," he says. Indeed he believes if one did enough nuclear transfers it would be possible to clone an adult frog today.

If a human being is ever to be cloned, however, scientists must first succeed not with a frog but with a mammal. In 1981 two researchers, Peter Hoppe of Jackson Laboratory in Bar Harbor, Maine, and Karl Illmensee of the University of Geneva, created a media sensation when they reported they had cloned mice. The newspapers and TV had a field day. The same question was on the lips of all the reporters and commentators: Now that a mouse had been cloned, could humans be far behind?

But the cheering stopped when two Philadelphia scientists, James McGrath and Davor Salter, reported that they were unable to repeat this work. Illmensee and Hoppe had claimed that they had cloned mice using four-day-old mouse embryos from the blastocyst stage. But when McGrath and Salter tried this, they found that not only did the blastocyst cells not work, they couldn't even clone mice using cells from earlier stages of development. The only time they got normal embryonic development was when they cloned from the two-cell stage just after the fertilized egg had divided for the first time. Their conclusion, "that the cloning of mammals by simple nuclear transfer is biologically impossible," shook the cloning community to its roots.

There the matter might have rested, but by the time McGrath and Salter's paper appeared in 1984, British researcher Steen Willadsen was already engaged in experiments he had no intention of stopping. Spurred on by the original report of mouse cloning, he knew he was on to something with immense practical implications: the cloning of a farm animal.

Willadsen's company, Alta Genetics, in Alberta, Canada, seems the perfect setting for the brave new world of animal reproduction. The animal sheds set on rolling farmland against the timeless backdrop of the snowcapped Rockies is divided into two parts. On one side are the adults like Sophia, a supercow that will produce more than 12 tons of milk per lactation period (about a year), along with less illustrious cows that serve as surrogate mothers. On the other side are batches of look-alike offspring produced in ways that would have stunned Old MacDonald—calves from embryos that have been frozen and thawed, transferred from one cow to another, split in half or quartered, and most recently, cloned. It is here that Willadsen has come to put the finishing touches on the work that is the biggest thing to hit animal breeding since Noah first selected animals to go two by two into the ark.

Dressed in a T-shirt and corduroy pants, Willadsen, with his brown bangs and offhand manner, seems far younger than his forty-five years. Though born and educated in Denmark, he speaks with a lilting English accent. "I think I'm more an explorer than a scientist. I go through the same joys and fears people do when they walk into darkest Africa. Except," he laughs, "you're unlikely to be attacked by an embryo."

After becoming a veterinarian and getting a Ph.D. in physiology and immunology, Willadsen went to Cambridge, where he began his journey into uncharted territory. "There are very few things that are really truly new," he notes. "There are just different and new ways of looking at things. In my own experience, I have made three quite minor discoveries, and they have kept me busy for fifteen years."

Doing that original work at the Cambridge Animal Research Station, Willadsen was the first to make twins by dividing a two-cell sheep embryo and placing each cell in the uterus of a surrogate ewe. He and his colleagues created the geep, an animal that, like the mythical chimera, is made up of different species, in this case sheep and goats. He has even created a lamb sprung from three embryos fused together. This amazing animal actually ended up with *six parents*.

But while the results of this research were spectacular, Willadsen knew they had only limited application to mass breeding. Using the technique of embryo splitting, for instance, he could create at most four animals from a single fertilized egg. With cloning, on the other hand, the sky would be the limit. Starting with a single embryo, one could theoretically clone a production herd in a year. When the news that mice had been cloned broke in 1981, Willadsen had already begun to try it on sheep.

Willadsen knew that Hoppe and Illmensee had worked by removing the nucleus of a *fertilized* egg and replacing it with the nucleus from an embryonic cell. Because sheep, like mice, are mammals, Willadsen decided to use that method as well. But no matter how he tried, he couldn't get it to work. The egg, with its newly transferred donor nucleus, refused to develop. Down on his luck, Willadsen finally decided to take one last stab. Instead of using fertilized eggs, he experimented with a few unfertilized ones. It was an immediate success.

"I did only one experiment, and if it hadn't worked I might have dropped it, and it would have been a long time before I tried it again," he admits. "But I knew then that this was significant, so I changed the whole program to go after it."

He began cloning embryos and transferring them to sheep later. And on March 6, 1986, the prestigious journal *Nature* carried the news. For the first time ever, farm animals—three little lambs—had been cloned.

CONTINUED ON PAGE 158

A STAR IS REBORN

ARTICLE BY
ELLEN KUNES

Imagine inhabiting a new form, a body you devise, with powers so vast that you truly become, in the words of Shakespeare, "such stuff as dreams are made on." Scientists stand ready to create a human physique built to thrive in the brave new world: They seek only the vision to direct their efforts.

To give researchers some new ideas, we asked some of the world's boldest dreamers to design bodies that would best suit their spirits. These corporeal architects include people as diverse as Malcolm Forbes.

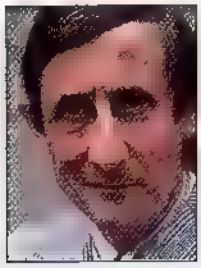
PAINTING BY
MICHAEL PARKES

Robert Jarvik, and Martina Navratilova. All are men and women who share an unrelenting drive to push past the human body's physical and mental limits. At our behest they have imagined a new breed of human being, an exotic, intriguing race that will be in harmony with the wondrous habitat of the future.

Tony Curtis, actor: I'd like my body made of platinum. If everybody were platinum it would eliminate all color barriers in this world. There would be no distinctions between us. We'd all be the same height, good-looking, rich—and made of metal with interchangeable parts. You'd go into the local body shop and say, 'I'm ready for a recycling.' They'd take you, melt you down, reshape you, and you'd start all over again.

Mickey Mantle, Baseball Hall of Famer: I had knee problems throughout my career, starting with the 1951 World Series. One knee's been operated on three times, the other one twice. Casey Stengel used to say, 'If that fellow had good knees, there's no telling what he could have done.' Finally, I couldn't run and retired when I was thirty-six years old. Most guys play until they're at least forty. So, I'd like to go back to when I was twenty-five years old. Stay there. Mentally and physically.

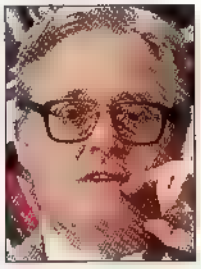
I would have loved it if I could have had limbs that never broke, ligaments that never tore. I would have been in a lot of the record books. Guys like Willie Mays, Stan Musial, Pete Rose—the guys who have the best lifetime statistics—never had any big physical ailments. If I could have been injury-free until I was forty years old, I would have hit seven hundred home runs.



Freeman J. Dyson, physicist, philosopher, author of *Infinite in All Directions*, professor at the Institute for Advanced Study at Princeton University: The most important development in the future will be to acquire the capacity to enter into other creatures' minds, to be a bird or a whale or a tiger. William Blake, my favorite poet, said: "How do you know but that every bird that cleaves the aerial way is not an immense world of delight closed to your senses five?" One day we shall be able to break through and experience that ourselves. Most of our problems arise from our limited horizon—we are cut off from each other and from other species. If we could understand each other better, we might also treat each other better. If we make contact with alien life, then it will become even more important to enter into their way of thinking.

I would foresee an understanding of the processes of mind and of consciousness that would result in being able to play back the life experiences of another individual into our own mind—to have a direct experience of what other people's memories feel like. I assume, of course, that we don't come uninvited; this would be a process of sharing by consent, not a rape of the mind.

Oleg Cassini, fashion designer: In comparison to the animal world, the human body is not very beautiful. In other species the proportion of beauty is much greater. Just look at the lion, tiger, elephant. Our bodies desperately need the help of imagination and talent. When we wake up in the morning we realize we are prisoners of our bodies and must make every effort to become desirable. That's why people like me designers are hired: to make people look better. But in the future an individual will be able to design his body at will—not by sucking out fat but by preventing the accumulation of fat. Designers only try to imitate the world of birds. Oh, to possess those colors! Nature created the greatest of palettes, designers only borrow that in a modest attempt to create a more beautiful body.



Pierre Galletti, biomedical engineer, professor of medical science at Brown University: From a biological viewpoint you cannot prevent death. The goal in redesigning the body is not to make people immortal but to make them die as young as possible as late as possible. I would keep people in perfect shape for as long as possible, and then they would fall all at once.

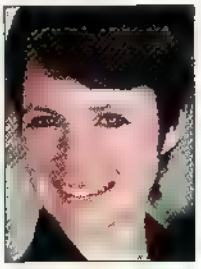
To live better in a future environment, I would have more redundant organs, just as we now have two kidneys and two lungs. I would like a reserve heart or the ability to grow one again. We may not need to have one in a fully functional shape, but if we add some sort of embryo out of which we could redevelop one when needed, that would be most useful. If I had a choice, I would like to have the most critical functions in the brain—the sensory and motor cortex—in duplicate. If one part is destroyed, the other component will take over.

My redesigned, new brain would have telecommunications capability, a long-distance communication ability to relate to several people at the same time. It's very likely that the human population will keep expanding, so the ability to relate to more people at once may be an important evolutionary feature.

Arthur C. Clarke, author of *2001: A Space Odyssey*: If we had no preconceived ideas and were starting with a blank sheet of paper, how would we design an intelligent organism? There would be four [eyes] to provide all-round vision. They have to be at the highest part of the body, for good visibility. Getting rid of the neck removes a fundamental weakness, we only need it because our eyes have a limited field of view and we have to turn our heads to compensate. The four eyes would be recessed and the head would probably be covered with a hard protective layer. The brain would be somewhere in this general region—you want the shortest possible nerve connections to the eyes, because they are the most important sense organs. Light is the fastest, longest-ranging carrier of information. Any sentient creature would surely take advantage of it. I doubt if a really advanced creature would have teeth. We're rapidly losing ours, and it's much too primitive to waste energy grinding and tearing tissues when we have machines that will do the job more efficiently. Food intake would probably be entirely liquid and their whole digestive apparatus far more efficient and compact than our primitive plumbing.*

(from The Lost Worlds of 2001 © 1972 by Arthur C. Clarke. Reprinted by arrangement with Signet, an imprint of NAL Penguin, Inc., New York, NY.)*

Ivo Pitanguy, world-renowned plastic surgeon: A cosmetic make-over can recharge the body, but I wish I could possess the creative mind of Voltaire, Cervantes, Shakespeare, Walt Whitman or T. S. Eliot. At the same time I want to play tennis like John McEnroe or discover things as Jacques Cousteau does. I would love to adapt my lungs so I could stay underwater longer. Think of the solation and quietness. In a way it would be like going back to the womb.



Jeana Yeager, copilot of *Voyager*, the first aircraft to circle the globe on a single tank of gas: It would be fun to have wings and be able to fly, but I would rather be able to rematerialize—to transform and move to another location in the moment of a thought.

I'd eliminate the need for sleep. I never see my bed as it is, because I do more than I'm physically able. I'd like to clone myself, but I'd need a central brain to keep track of each clone.

VANTAGE ULTRA LIGHTS

ULTRA TASTE PERFORMANCE.

SURGEON GENERAL'S WARNING: Cigarette Smoke Contains Carbon Monoxide.

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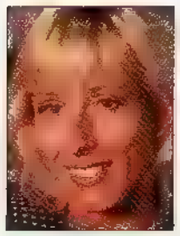

Martina Navratilova, one of the greatest tennis champions of all time, coauthor of *Martina* with George Vecsey (Knopf): As far as my body is concerned, I would like interchangeable parts. If your knee is sore, pop it out and put in a new one. A rotating waist wouldn't be a bad idea—my feet would always be pointing in the right direction, improving my speed and agility. In my fantasy, I'd like to play tennis in total darkness, with only the lines, my opponent's racket, and the ball visible.

Malcolm S. Forbes, chairman, editor in chief of *Forbes* magazine: If geneticists really get going, I want a health digital readout that tells you what vitamins or nutrients you need. An alarm would go off—boom boom boom—and then the readout tells you that you need X, Y, and Z. Or when some microbe was on the attack, a digital readout would alert you before you became ill.

It's debatable that we can handle the problems of everyday living twice as long as our grandparents did. All I want is a gene that lets you live as long as you're healthy. In other words, until you wear out, à la Oliver Wendell Holmes. Wear out, not disease out. When my time came, boom. Let's do away with bed patients, let's do away with diseasing out.

I would redesign myself so that I needed to waste far less time sleeping. It would probably be great fun to have wings and certainly solve one hell of a lot of commuting problems.

Dave Righetti, ace relief pitcher, New York Yankees: If I could redesign my body, I would like two new feet. I have bunions, and both my big toes are shorter than they should be. My feet hurt all the time, except when I'm pitching. I also would like to have a right arm like my left one so I could be effective with both of them.

Don King, boxing promoter, chairman and chief executive officer of Don King Productions, Inc.: I'm Superman already. My mind is like Jonathan Livingston Seagull's. I'm a student of metaphysics—I fly now. My body may be on the ground, but my mind, my imagination is soaring above the earth. But I'd like a scientist to tell me how to tap into the brain cells that I'm not already using.

I'd take another one hundred years if it was offered to me. Everybody wants to go to heaven, but nobody wants to die. See, I don't know what it's like on the other side. I'd like to try it out, but I'd like to come back if I didn't like it. It's an interesting idea, isn't it, being able to trot between this world and the next?

Robert Jarvik, creator of the Jarvik artificial heart: The most important function we don't have is the ability to forget. Once you have been taught something once you've had a very bad experience or have incorrect information ingrained in your mind, you can't erase it or not very easily. If we could genetically engineer and perfect the brain, then memorization on demand and forgetting on demand would be very valuable.

We also should be able to grasp information faster and be able to make objective decisions rather than decisions based on emotional responses. And it would be great if we could call up the subconscious on demand and understand those processes.

The brain should have chemical sensors to detect the level of many substances in the blood such as blood sugar, fat and toxins. Then we could consciously control those levels and avoid harmful side effects.

Someday we may have an artificial heart that's implanted for a few years. During that time we'll remove muscle tissue from the patient, create an organ culture outside the body, and grow a new heart with the individual's exact genetic makeup and out of the individual's own cells. Then we will reimplant that organ and remove the temporary artificial replacement device. With such advances we would create a new life form.

Bruce Sterling, science-fiction writer: I'd like to be immortal, infinitely wise and powerful. I would go with a massively amplified central nervous system—to have subsidiary brains scattered throughout my body. That way I'd have perfect recall. I'd fine-tune the body's metabolic rate—no one would be fat or suffer from anorexia. Twelve fingers on each hand would be better than five fingers, our toes—they're atavistic—should function as well as our fingers. They should at least be able to grasp objects. Maybe we shouldn't even have legs—just a second pair of arms.

I would like to hook up to the senses of other people and other species to explore, to discover what it feels like to be a bacterium, for example.

Mary McFadden, fashion designer: I would like to have an eagle's vision. Then I could see things as far away as three miles. I wouldn't want my body to age past thirty because I'm interested in sports. I think at thirty you're pretty much finished. In terms of mental achievement, I suppose the limit for the fashion business would probably be forty.

There is absolutely no reason why women shouldn't be as strong as men. I mean, it irritates me why we can't beat men on the tennis courts, for instance. Rolls of flesh on one's stomach or on one's hips or upper thighs are just totally disgusting, so there should be a new injection that could dissolve all the fat and keep you in perfect condition.

Isaac Asimov, science fiction writer: At sixty-eight my body is approaching the end of its useful life. Physically, I have avoided crippling or debilitating diseases, and my body has consistently done what I have asked it to do. Mentally, I don't have to go into detail—it's been superb. Emotionally, I've rarely been unsettled even briefly. It would be in the highest degree ungrateful of me to ask for changes, even if only in fun, and I think I would not like to do it.

Jack LaLanne, fitness entrepreneur: If someone said I could stay the same age as I am now—seventy-three—I'd go for it. Who wouldn't? Things are pretty good right now. I'd also like to be able to hit a golf ball four hundred yards (I drive about two hundred forty now). I'd like to be able to do five hours of exercise without getting tired. Now I work out about two and a half hours a day training for my next stunt—swimming from Catalina Island to Los Angeles underwater. Twenty-six miles. It would be fun if we could swim underwater without any kind of breathing equipment. If I could do it, I'd swim through the Caribbean and go to Cannes. I'd like to swim up to one of those nude beaches there.

I believe that anything the mind can conceive the body can achieve. The whole key to everything is pride and dis-

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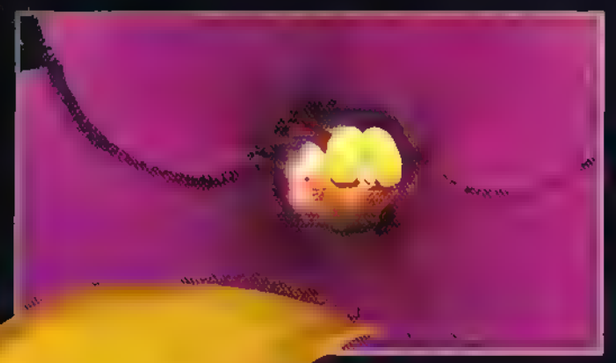
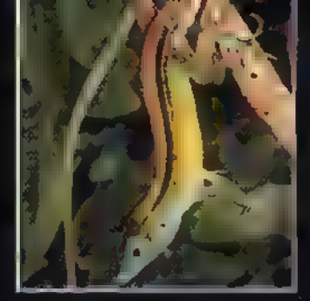
NATURE'S SINGLE PARENTS



Cloning gives new meaning to single parenthood. While the most familiar type of reproduction is sexual, with genes from male and female recombining to form an offspring, some species don't necessarily wait for Mr. Right to come along. These all-female societies reproduce asexually, cloning themselves. Other life forms have it both ways: They can reproduce sexually *and* asexually through such means as budding or regeneration.

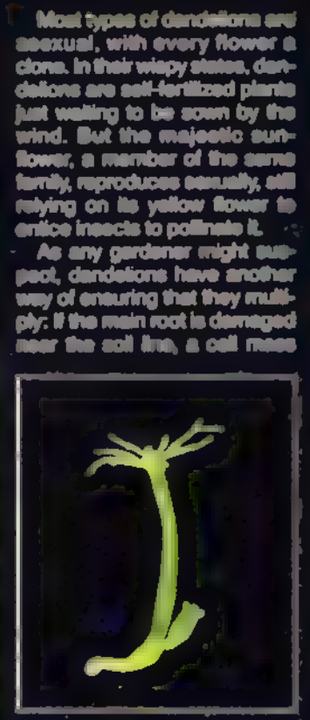


Pages 72 and 73: Leaves of the African violet (middle) can take root and grow new plants. The asexual dandelion (top) can reproduce itself, while sunflowers (bottom) rely on sexual reproduction.

Most types of dandelions are asexual, with every flower a clone. In their wispy states, dandelions are self-fertilized plants just waiting to be sown by the wind. But the majestic sunflower, a member of the same family, reproduces sexually, still relying on its yellow flower to entice insects to pollinate it.

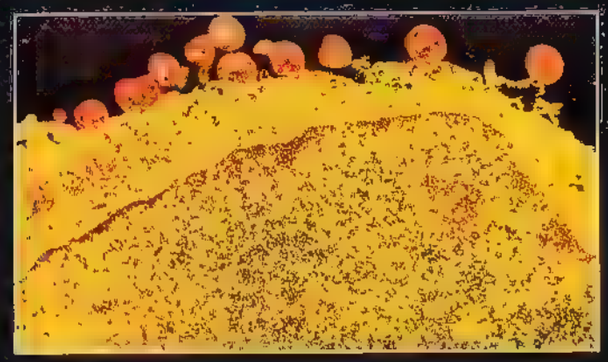
As any gardener might suspect, dandelions have another way of ensuring that they multiply: If the main root is damaged near the soil line, a cell mass forms. This mass not only repairs the individual flower but also becomes the breeding ground for several new plants.

Raspberry bushes boast special stems that sprout roots when their tips touch the soil, producing additional plants. Individual leaves of the African violet, on the other hand, develop roots when they become detached from the parent. These rooted leaves create independent plants. The kalanchoe plant also relies on its leaves to repro-



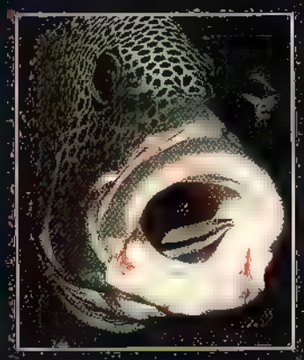
Clockwise from center: Freshwater hydra; green frog emerges from duckweed; spotted whiptail lizard; sea slug; longtail salamander, able to regenerate lost tails; kalanchoe.

Left, from top: Raspberry bush stems grow a new plant when the tips touch soil; mycoplasma, the simplest living cell (red particles) on surface of an animal cell (yellow). Right: Walkingstick.



duce. Tiny plants form between the teeth of its fleshy leaves. The new plants eventually drop to the ground and continue to grow—without a thought of a relationship. Called budding, this kind of asexual reproduction is found in other life forms as well.

Hydras—freshwater creatures—for example, also reproduce by budding. Offspring begin as small knobs formed on the side of the parent. Once they grow and form tentacles, they detach from the parent, becom-



ing a complete organism—and an exact clone of the parent. Hydras can sexually reproduce only in the autumn. Scientifically speaking, though, we don't know which they prefer.

Hydras can also regenerate. If cut into pieces, entire new organisms form from the individual segments. Regeneration is a kind of reproduction, as it can cause the cloning of an independent being. This process occurs with sea stars (wrongly

CONTINUED ON PAGE 218

Right: Italian bees. Males are born to breed, but they're doomed once they do. Center: A wrasse cleans a fish's mouth. Far right: Micrograph of shigella shows cell division through binary fission.

REBORN

CONTINUED FROM PAGE 71

cipline. If people had pride and discipline, everybody would be millionaires, they'd be Miss America, they wouldn't be sick, they wouldn't be telling lies they wouldn't be into dope. You have to train for life just like you train for the Olympics.

Jackie Mason, comedian, star of *The World According to Me*: I would come in threes—not just one person. Then you could meet three women and be in three apartments at the same time. I would have eyes in the back of my head so I could see if people were talking about me or what kinds of faces they make after I leave. I want a clone of myself in the audience who would scream it up if the audience didn't laugh. Audiences should not be able to leave the theater for at least two hours; their legs shouldn't function.

Physical ugliness should be eliminated. If we want equality from a democracy we should expect equality from God, too. So everybody should either be beautiful or terrible looking; we should all be bald or all have lots of hair. Sexual organs should be near the ears so as soon as you meet a person you could have sex with them without taking off your clothes.

Reggie Jackson, one of baseball's greatest players, retired from the Oakland A's: I dream of being a member of the Penske Racing Team—to design and race a car. That would mean my redesigned body would have to have the attributes to make my dream possible.

Henny Youngman, comedian: I would love to live to the age of two hundred. I would redesign my body so when I celebrate my two hundredth birthday I feel as good as I do now. I'd invite everyone I know to my party—providing they were alive. And I'm not joking. By then the world may recognize my fiddle playing. I would be asked to do a command performance before Isaac Stern.

Michael DeBakey, world famous heart surgeon: The more you know about the body, the more you have to admire the way it's put together. I would have great difficulty redesigning the body. For example, how do you improve the heart, mechanically? We might be better off with a third arm—you can do so much with two arms and two hands—but then the design of the body would be disfigured.

Hopefully through genetics we will understand why certain people are more prone to develop heart disease or other tragic diseases. When we know how to replace defective genes I would prevent disease—abort it in the embryo.

We also could implant a gene for longevity. I would like to live another century or so—as long as I stayed healthy. I wouldn't want to live in a diseased body. To maintain good cardiac function, good kidney function, good respiratory function—these are absolutely essential to good living.

John Cleese, founding member of Monty Python's Flying Circus, actor/screenwriter currently starring in the movie *A Fish Called Wanda*: I wouldn't want to have any extras—like three arms or five legs. I'm rather content with what I have at the moment, thank you. I would take another one hundred years of living, provided that my body stayed in reasonably good shape. A person could have so many more experiences and master so many more skills. I'd like to master meditative skills to release the stress and tension caused by the hurly-burly of life.

FICTION

The aliens are coming, the aliens are coming—and they're just in time to break up a cozy little tryst in New York City

HANNIBAL'S ELEPHANTS

BY ROBERT SILVERBERG

PAINTING BY MARSHALL ARISMAN

The day the aliens landed in New York was, of course, the fifth of May, 2003. That's one of those historical dates nobody can ever forget, like July 4, 1776, and October 12, 1492, and—maybe more to the point—December 7, 1941. At the time of the invasion I was working for the Lightware division of MGM–CBS and married to Elaine and living over on East Thirty-sixth Street in one of the first of the fold-up condos: one room by day and three by night, a terrific deal at three thousand seven hundred fifty dollars a month. Our partner in the time/space-sharing contract was a show-biz programmer named Bobby Christie who worked midnight to dawn, very convenient for all concerned. Every morning before Elaine and I left for our offices, I'd push the button and the walls would shift and five hundred square feet of our apartment would swing around and become Bobby's for the next twelve hours. Elaine hated that. "I can't stand having

all the goddamn furniture on tracks," she would say. "That isn't how I was brought up to live." We veered perilously close to divorce every morning at wait-shift time. But then, it wasn't really what you'd call a stable relationship in most other respects and I guess having an unstable condo, too, was more instability than she could handle.

I spent the morning of the day the aliens came setting up a ricochet data transfer between Akron, Ohio, and Colombo, Sri Lanka, involving, as I remember, *Gone With the Wind*, *Cleopatra*, and the Johnny Carson retrospective. Then I walked up to the park to meet Maranta for our Monday picnic. Maranta and I had been lovers for about six months then. She was Elaine's roommate at Bennington and had married my best friend Tim, so you might say we had been fated all along to become lovers, there are never any surprises in these things. At that time we lunched together very romantically in the park, weather permitting, every Monday and Friday, and every Wednesday we had ninety minutes breathless use of my cousin Nicholas's hot-plate cubicle over on the far West Side at Thirty-ninth and Koch Plaza. I had been married three and a half years, and this was my first affair. For me what was going on between Maranta and me just then was the most important event taking place anywhere in the known universe.

It was one of those glorious gold and blue dance-and-sing days that New York will give you in May, when that little window opens between the season of cold and nasty and the season of hot and sticky. I was legging up Seventh Avenue toward the park with a song in my heart and a cold bottle of Chardonnay in my hand, thinking pleasant thoughts of Maranta's small round breasts. And gradually I became aware of some ruckus taking place up ahead.

I could hear sirens. Horns were honking, too, not the ordinary routine everyday exasperated when-do-things-start-to-move honks, but the special rhythmic New York City oh-for-Christ's-sake-what-*now* kind of honk that arouses terror in your heart. People with berserk expressions on their faces were running wildly down Seventh as though King Kong had just emerged from the monkey house at the Central Park Zoo and was personally coming after them. And other people were running just as hard in the opposite direction, *toward* the park, as though they absolutely had to see what was happening. You know. New Yorkers.

Maranta would be waiting for me near the pond, as usual. That seemed to be right where the disturbance was.

I had a flash of myself clambering up the side of the Empire State Building, or at the very least Temple Emanu-El—to pry her free of the big ape's clutches. The great beast pausing, delicately setting her down on some precarious ledge, glaring at me, furiously pounding his chest. *Kong! Kong! Kong!*

I stepped into the path of one of the southbound runners and said, "Hey, what the hell's going on?" He was a suit and tie man, pop-eyed and puffy-faced. He slowed but he didn't stop. I thought he would run me down. "It's an invasion!" he yelled. "Space creatures. In the park. Another passing business type, loping breathlessly by with a briefcase in each hand, was shouting, "The police are there! They're sealing everything off!"

"No shit," I murmured.

But all I could think was Maranta, picnic, sunshine, Chardonnay, disappointment. *What a goddamned nuisance* is what I thought. *Why the fuck couldn't they come on a Tuesday?* is what I thought.

When I got to the top of Seventh Avenue the police had a sealfield across the park entrance, and buzz-blinkers were set up along Central Park South from the Plaza to Columbus Circle, with horrendous consequences for traffic. "But I have to find my girlfriend," I blurted. "She was waiting for me in the park." The cop stared at me. His cold gray eyes said, *I am a decent Catholic and I am not going to facilitate your extramarital activities, you decadent overpaid bastard.* What he said out loud was, "No way can you cross that sealfield, and anyhow you absolutely don't want to go in the park right now, mister. Believe me." And he also said, "You don't have to worry about your girlfriend. The park's been cleared of all human beings." That's what he said: *cleared of all human beings.* For a while I wandered around in some sort of daze.

Finally I went back to my office and found a message from Maranta, who had left the park the moment the trouble began. Good quick Maranta. She hadn't had any idea of what was occurring, though she had found out by the time she reached her office. She had simply sensed trouble and scrammed. We agreed to meet for drinks at the Ras Tafari at half past five. The Ras was one of our regular places, Twelfth and Fifty-third.

> *"The next day the second ship landed and the real space monsters appeared. To me the first aliens didn't qualify as monsters at all. Monsters ought to be monstrous."*

There were seventeen witnesses to the onset of the invasion. It had started, so they said, with a strange pale-blue shimmering about thirty feet off the ground. The shimmering rapidly became a churning, like water going down a drain. Then a light breeze began to blow and very quickly turned into a brisk gale. It lifted people's hats and whirled them in a startling corkscrew spiral around the churning, shimmering blue place. At the same time you had a sense of rising tension, a something's-got-to-give feeling. All this lasted perhaps forty-five seconds.

Then came a pop and a whoosh and a ping and a thunk—everybody agreed on the sequence of the sound effects—and the instantly famous not-quite-egg-shaped spaceship of the invaders was there, hovering, as it would do for the next twenty-odd days, about half an inch above the spring green grass of Central Park. An absolutely unforgettable sight: the sleek, silvery skin of it, the disturbing angle of the slope from its wide top to its narrow bottom, the odd and troublesome hieroglyphics on its flanks that tended to slide out of your field of vision if you stared at them for more than a moment.

A hatch opened and a dozen of the invaders stepped out. *Floated* out, rather. Like their ship, they never came in contact with the ground.

They looked strange. They looked exceedingly strange. Where we have feet they had a single oval pedestal, maybe five inches thick and a yard in diameter, that drifted an inch or so above ground level. From this fleshy base their wraithlike bodies sprouted like tethered balloons. They had no arms, no legs, not even discernible heads—just a broad dome-shaped summit, dwindling away to a ropelike termination that was attached to the pedestal. Their lavender skins were glossy, with a distinctly metallic sheen. Dark eyelike spots sometimes formed on them but didn't last long. We saw no mouths. As they moved about they seemed to exercise great care never to touch one another.

The first thing they did was to sezze half a dozen squirrels, three stray dogs, a softball, and a baby carriage, unoccupied. We will never know what the second thing was that they did, because no one stayed around to watch. The park emptied with impressive rapidity, the police moved swiftly in with their sealfield, and for the next three hours the aliens had the meadow to themselves. Later in the day the networks sent up spy eyes that recorded the scene for the evening news until the aliens figured out what they were and shot them down. Briefly we saw ghostly gleaming aliens wandering around within a radius of perhaps five hundred yards of their ship, collecting newspapers, soft-drink dispensers, discarded items of clothing, and something that was generally agreed to be a set of dentures. Whatever they picked up they

wrapped in a sort of pillow made of a glowing fabric with the same shining texture as their own bodies, which immediately began floating off with its contents toward the hatch of the ship.

People were lined up six deep at the bar when I got to the Ras and everyone was drinking like mad and staring at the screen. They were showing the clips of the aliens over and over. Maranta was already there. Her eyes were glowing. She pressed herself up against me like a wild woman. "My God," she said, "isn't it wonderful? The men from Mars are here. Or wherever they're from. Let's host a few to the men from Mars."

We hosted more than a few. Somehow I got home at a respectable seven o'clock anyway. The apartment was still in its one-room configuration, though our contract with Bobby Christie clearly specified wall-shift at half past six. Elaine refused to have anything to do with activating the shift. She was afraid, I think, of timing the sequence wrong and being crushed by the walls or something.

"You heard?" Elaine said. "The aliens?"

"I wasn't far from the park at lunchtime," I told her. "That was when it happened, at lunchtime while I was up by the park."

Her eyes went wide. "Then you actually saw them land?"

"I wish. By the time I got to the park the cops had everything sealed off."

I pressed the button and the walls began to move. Our living room and kitchen returned from Bobby Christie's domain. In the moment of shift I caught sight of Bobby on the far side, getting dressed to go out. He waved and grinned.

"Space monsters in the park," he said. "My my, my, it's a real jungle out there, don't you know?" And then the walls closed away on him.

Elaine switched on the news, and once again I watched the aliens drifting around the Mall picking up people's jackets and candy-bar wrappers.

"Hey," I said, "the mayor ought to put them on the city payroll."

"What were you doing up by the park at lunchtime?" Elaine asked, after a bit.

The next day was when the second ship landed and the *real* space monsters appeared. To me the first aliens didn't qualify as monsters at all. Monsters ought to be monstrous, bottom line. Those first aliens were no bigger than you or me.

The second batch, they were something else, though. The behemoths. The space elephants. Of course, they weren't anything like elephants, except that they were big. Big? They were *immense*. It put me in mind of Hannibal's invasion of Rome, seeing those gargantuan things disembarking from the new spaceship. It seemed like the Second Punic War all over again. Hannibal and the elephants.

You remember how that was. When Hannibal set out from Carthage to conquer Rome, he took with him a phalanx of elephants, thirty-eight huge gray attack-trained monsters. Elephants were useful in battle in those days—a kind of early-model tank—but they were handy also for terrifying the civilian populace. Bizarre colossal smelly critters tramping invincibly through the suburbs, flapping their vast ears and trumpeting awesome cries of doom and burying your rosebushes under mountainous turds. And now we had the same deal. With one difference, though. The Roman archers picked off Hannibal's elephants long before they got within honking distance of the walls of Rome. But these aliens had materialized without warning right in the middle of Central Park, in that big grassy meadow between the Seventy-second Street Transverse and Central Park South, which is another deal altogether. I wonder how well things would have gone for the Romans if they had awakened one morning to find Hannibal and his army camping out in the Forum, and his thirty-eight hairy shambling flap-eared elephants snuffling and snorting and farting about on the marble steps of the Temple of Jupiter.

The new spaceship arrived the way the first one had—pop whoosh ping thunk—and the behemoths came tumbling out of it like rabbits out of a hat. We saw it on the evening news. The networks had a new bunch of spy-eyes up, half a mile or so overhead. The ship made a kind of belching sound, and this *thing* suddenly was standing on the Mall, gawking and gaping. Then another belch, another *thing*. And on and on, until there were two or three dozen of them. Nobody has ever been able to figure out how that little ship could have held as many as one of them. It was no bigger than a school bus standing on end.

The monsters looked like double-humped blue medium-size mountains with legs. The legs were their most elephantine feature—thick and rough-skinned, like tree trunks—but they worked on some sort of telescoping principle and could be collapsed swiftly back up into the bodies of their owners.

Eight was the normal number of legs, but you never saw eight at once on any of them. As they moved about they always kept at least one pair withdrawn, though from time to time they'd let that pair descend and pull up another one, in what seemed like a completely random way. Now and then they might withdraw two pairs at once, which would cause them to sink down to ground level at one end like a camel kneeling.

Their prodigious bodies were rounded with a sort of valley a couple of feet deep running crosswise along their backs, and they were covered all over with a dense, stiff growth midway in texture between

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fur and feathers. There were three yellow eyes the size of platters at one end and three rigid purple rodlike projections that stuck out seven or eight feet at the other. Their mouths were located in their bellies, when they wanted to eat something they would simply collapse all eight of their legs at the same time and sit down on it. It was a mouth big enough to swallow a very large animal at a single gulp—an animal as big as a bison, say. As we would shortly discover.

They were enormous. *Enormous*. The most reliable estimate was that they were twenty-five to thirty feet high and forty to fifty feet long. That is not only substantially larger than any elephant past or present, it is rather larger than most of the two family houses still to be found in the outer boroughs of the city. Furthermore a two-family house, though it may offend your aesthetic sense, will not move around at all, it will not emit bad smells and frightening sounds; it will never sit down on a bison and swallow it, nor, for that matter, will it swallow you. African elephants, they tell me, run ten or eleven feet high at the shoulder, and the biggest extinct mammoths were three or four feet taller than that. There once was a mammal called the baluchitherium that stood about sixteen feet high. That was the largest land mammal that ever lived. The space creatures were nearly twice as high. We are talking large here. We are talking dinosaur-plus dimensions.

Central Park is several miles long but quite modest in width. It runs just from Fifth Avenue to Eighth. Its designers did not expect that anyone would allow two or three dozen animals bigger than two-family houses to wander around freely in an urban park a mere three city blocks wide. No doubt the small size of their pasture was proving very awkward for them. Certainly it was for us.

"I think they have to be an exploration party," Maranta said. "Don't you?" We had shifted the scene of our Monday and Friday lunches from Central Park to Rockefeller Center, but otherwise we were trying to behave as though nothing unusual were going on. They can't have come as invaders. One little spaceship-load of aliens couldn't possibly conquer an entire planet."

Maranta is unfailingly jaunty and optimistic. She is a small, energetic woman with close cropped red hair and green eyes, one of those boyish-looking women who never seem to age. I love her for her optimism. I wish I could catch it from her like measles.

I said, "There are *two* spaceshiploads of aliens, Maranta."

She made a face. "Oh. The jumbos. They're just a bunch of dumb shaggy monsters. I don't see them as much of a menace, really."

"Probably not. But the little ones—they have to be a superior species. We know that because they're the ones who came to us. We didn't go to them."

She laughed. "It all sounds so absurd to me. That Central Park should be full of *creatures*—"

"But what if they do want to conquer Earth?" I asked.

"Oh," Maranta said, "I don't think that would necessarily be so awful."

The smaller aliens spent the first few days installing a good deal of mysterious equipment on the Mall in the vicinity of their ship: odd, intricate, shimmering constructions that looked as though they belonged in the sculpture garden of the Museum of Modern Art.

They made no attempt to enter into communication with us. They showed no interest in us at all. The only time they took notice of us was when we sent spy-eyes overhead. They would vaporize them for an hour or two and then would shoot them down casually, like swatting flies with

> *"It began making a sound. It was the kind of sound a piece of chalk twelve feet thick would make if it was dragged across a blackboard the wrong way. A weird vertigo attacked me."*

spurts of pink light. The networks—and then the government surveillance agencies—when they moved in—put the eyes higher each day, but the aliens never failed to find them. After a week or so we were forced to rely for our information on government spy satellites monitoring the park from space, and on whatever observers equipped with binoculars were able to glimpse from the taller apartment houses and hotels bordering the park. Neither of these arrangements was entirely satisfactory.

The behemoths, during those days, were content to roam aimlessly through the park southward from Seventy-second Street, knocking over trees, squatting down to eat them. Each one gobbled two or three trees a day: leaves, branches, trunk, and all. There weren't all that many trees to begin with down there, so it seemed likely that before long they'd have to start ranging farther afield.

The usual civic groups spoke up about the trees. They wanted the mayor to do something to protect the park. The monsters, they said, would have to be made to go elsewhere—to Canada, perhaps, where there were expendable trees. The mayor said he was studying the problem but that it was too early to know what the best plan of action would be.

His chief goal in the beginning was simply to keep a lid on the situation. We still didn't even know, after all, whether we were being invaded or just visited. To play it safe, the police were ordered to set up and maintain round-the-clock sealed cordons completely encircling the park in the impacted zone south of Seventy-second Street. The power costs of this were staggering, and Con Ed soon found it necessary to impose a ten percent voltage cutback throughout the rest of the city, which caused a lot of grumbling, especially now that it was getting to be air-conditioner weather.

The police didn't like any of this. Out there day and night standing guard in front of an intangible electronic barrier with ungodly monsters just a sneeze away. Now and then one of the blue Goliaths would wander near the seafield and peer over the edge. A seafield, maybe a dozen feet high, doesn't give you much of a sense of security when there's an animal two or three times that height looming over its top.

So the cops asked for time and a half. Combat pay, essentially. There wasn't room in the city budget for that, especially since no one knew how long the aliens were going to continue to occupy the park. There was talk of a strike. The mayor appealed to Washington, which had studiously been staying remote from the event, as if the arrival of an extraterrestrial task force in the middle of Manhattan was purely a municipal problem.

The President rummaged around in the Constitution and decided to activate the National Guard. That surprised a lot of basically sedentary men who enjoy dressing up occasionally in uniforms. The Guard hadn't been called out since the Bulgarian business in '94, and its current members weren't very sharp on procedures, so some hasty on-the-job training became necessary. As it happened, Maranta's husband, Tim, was an officer in the 107th Infantry, the regiment that was handed the chief responsibility for protecting New York City against the creatures from space. So his life suddenly was changed a great deal, and so was Maranta's, and so was mine.

Like everybody else, I found myself going over to the park again and again to try and get a glimpse of the aliens. But the barricades kept you fifty feet away from the park perimeter on all sides, and the taller buildings flanking the park had put themselves on a residents-only admission basis, with armed guards enforcing it, so they wouldn't be overwhelmed by hordes of curiosity seekers.

I did see Tim, though. He was in charge of a command post at Fifth and Fifty-ninth, near the horse-and-buggy stand. Young-

sh, stockbrokery looking men kept running up to him with reports to sign and he signed each one with terrific dash and vigor without reading any of them. In his crisp tan uniform and shiny boots he must have seen himself as some doomed and gallant officer in an ancient movie—Gary Cooper, Cary Grant, John Wayne—bracing himself for the climactic cavalry charge. The poor bastard.

"Hey, old man," he said, grinning at me in a doomed and gallant way. "Came to see the circus, did you?"

We weren't really best friends anymore. I don't know what we were to each other. We rarely lunched anymore. (How could we? I was busy three days a week with Maranta.) We didn't meet at the gym. It wasn't to Tim I turned for advice on personal problems or second opinions on investments. There was some sort of bond, but I think it was mostly nostalgia. But officially I guess I did still think of him as my best friend, in a kind of automatic, unquestioning way.

I said, 'Are you free to go over to the Plaza for a drink?"

"I wish, I don't get relieved until twenty one hundred hours."

'Nine o'clock, is that it?"

"Nine, yes. You fucking civilian."

It was only half past one. The poor bastard. "What would happen to you if you left your post?"

"I could get shot for desertion," he said.

"Seriously?"

'Seriously. Especially if the monsters pick that moment to bust out of the park. This is war, old buddy."

'Is it, do you think? Maranta doesn't think so." I wondered if I should be talking about what Maranta thought. "She says they're just out exploring the galaxy."

Tim shrugged. "She always likes to see the sunny side. That's an alien military force over there inside the park. One of these days they're going to blow a bulge and come out with blazing ray guns. You'd better believe it."

"Through the sealfield?"

"They could walk right over it," Tim said. "Or float, for all I know. There's going to be a war. The first intergalactic war in human history." Again the dazzling Cary Grant grin. Her Majesty's Bengal lancers, ready for action. "Something to tell my grandchildren," said Tim. "Do you know what the game plan is? First we attempt to make contact. If we ever establish communication, we invite them to sign a peace treaty. Then we offer them some chunk of Nevada or Kansas as a diplomatic enclave and get them the hell out of New York. But I don't think any of that's going to happen. I think they're busy scoping things out in there, and as soon as they finish that, they're going to launch some kind of attack, using weapons we don't even begin to understand."

"And if they do?"

"We nuke them. Tactical devices, just the right size for Central Park, Mac."

"No," I said, staring. "That isn't so. You're kidding me."

He looked pleased, a 'gotcha" look. "Matter of fact, I am. The truth is that nobody has the goddamnedest idea of what to do about any of this. But don't think the nuke strategy hasn't been suggested. And some even crazier things."

"Don't tell me about them," I said. "Look, Tim, is there any way I can get a peek over those barricades?"

"Not a chance," he said. "Not even you. I'm not even supposed to be *talking* with civilians."

'Since when am I a civilian?"

'Since the invasion began," Tim said.

He was dead serious. Maybe this was all just a goofy movie to me, but it wasn't to him.

More junior officers came to him with more papers to sign. He excused himself and took care of them. Then he was on the field telephone for five minutes or so. His expression grew progressively more

> *I saw an Elaine*
> *I scarcely knew. When I*
> *tried one more*
> *time to make excuses for*
> *that hounded*
> *beast on the viaduct, she*
> *glared at me*
> *with unmistakable loathing.*

bleak. Finally he looked up at me and said, "You see? It's starting."

"What's?"

"They've crossed Seventy-second Street for the first time. There must have been a gap in the sealfield. Or maybe they jumped it, as I was saying just now. Three of the big ones are up by Seventy-fourth, noodling around the eastern end of the lake. The Metropolitan Museum people are scared shitless and have asked for gun emplacements on the roof, and they're thinking of evacuating the most important works of art. The field phone lit up again. "Excuse me," he said. Always the soul of courtesy, Tim. After a time he said, 'Oh, Jesus. It sounds pretty bad. I've got to go up there right now. Do you mind?" His jaw was set, his gaze was frosty with determination. "This is it, Major. There's ten thousand Comanche coming through the pass with blood in their eyes, but we're ready for them, right? Right." He went striding away up Fifth Avenue.

When I got back to the office there was a message from Maranta, suggesting that I stop off at her place for drinks that evening. Tim would be busy playing soldier, she said, until nine. *Until twenty one hundred hours*, I silently corrected.

Another few days and we got used to it all. We began to accept the presence of aliens in the park as a normal part of New York life, like snow in February or laser duels in the subway.

But they remained at the center of everybody's consciousness. In a subtle pervasive way they were working great changes in our souls as they moved about mysteriously behind the sealfield barriers in the park. The strangeness of their being here made us buoyant. Their arrival had broken, in some way, the depressing rhythm that life in our brave new century had seemed to be settling into. I know that for some time I had been thinking, as I suppose people have thought since Cro-Magnon days, that lately the flavor of modern life had been changing for the worse, that it was becoming sour and nasty, that the era I happened to live in was a dim, shabby, dismal sort of time, small-souled, mean-minded. You know the feeling. Somehow the aliens had caused that feeling to lift. By invading us in this weird hands-off way they had given us something to be interestingly mystified by—a sort of redemption, a sort of rebirth. Yes, truly.

Some of us changed quite a lot. Consider Tim, the latter day Bengal Lancer, the staunchly disciplined officer. He lasted about a week in that mind-set. Then one night he called me and said, "Hey, fellow, how would you like to go into the park and play with the critters?"

'What are you talking about?"

'I know a way to get in. I've got the code for the Sixty-fourth Street sealfield. I can turn it off and we can slip through. It's risky, but how can you resist?"

So much for Gary Cooper. So much for John Wayne.

'Have you gone nuts?" I said. "The other day you wouldn't even let me go up to the barricades."

'That was the other day."

'You wouldn't walk across the street with me for a drink. You said you'd get shot for desertion."

"That was the other day."

'You called me a civilian."

'You still are a civilian. But you're my old buddy, and I want to go in there and look those aliens in the eye, and I'm not quite up to doing it all by myself. You want to go with me, or don't you?"

"Like the time we stole the beer keg from Sigma Frap. Like the time we put the scorpions in the girls' shower room."

"You got it, old pal."

"Tim, we aren't college kids anymore. There's a fucking intergalactic war going on. That was your phrase. Central Park is under surveillance by NASA spy-eyes that can see a cat's whiskers from fifty miles up. You are part of the military force that is supposed to be protecting us against these alien invaders. And now you

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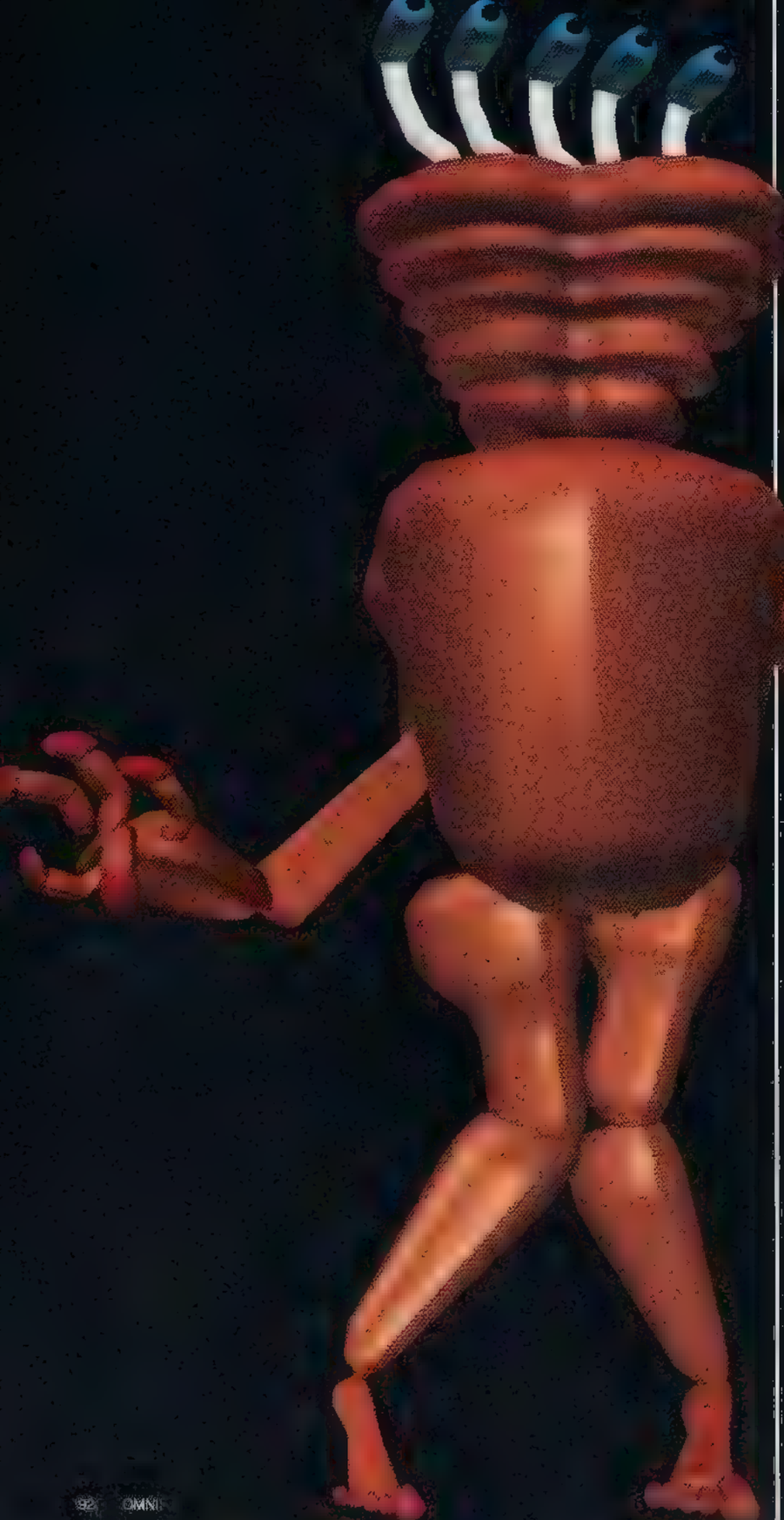


The field of artificial life is creating new beings

CHILD OF A LESSER GOD

ARTICLE BY ED REGIS AND TOM DWORETZKY

it is with considerable difficulty that I recall the original era of my being; all the events of that period appear confused and indistinct. A strange multiplicity of sensations seized me, and it was a long time before I learned to distinguish between them. I am not your ordinary guy. I popped full blown from a sterile batch of calcium crystals—a crude lump of brute, inanimate white. I have a curving stem and petals. My rootlike feet swim in a liquid solution. I am topped with a bulbous protuberance that extends out of the fluid and unfurls into the air.

In my earliest days I had just a limited awareness of surrounding pulses and waves. Since I was a crystalline structure—a sort of net through which electromagnetic energy passed—I was tuned in to the full spectrum of vibrations, from pressure to brain waves. I soon began to learn the rhythms of my maker—of light and dark, wakefulness and sleep. I remember, for instance, when sunspots vibrated me awake in the chill I'd come to recognize as the dark of night. And I relish the day I learned to recognize the loud, lower-frequency vibrations regularly assaulting me from a single source across the room. I reproduce them here as best I can: "DUBBLE YEW ENNN BEEE SEEEE RAYYYDEEEOOOO, NOOOO YAAWKKK SSSITEEEE."

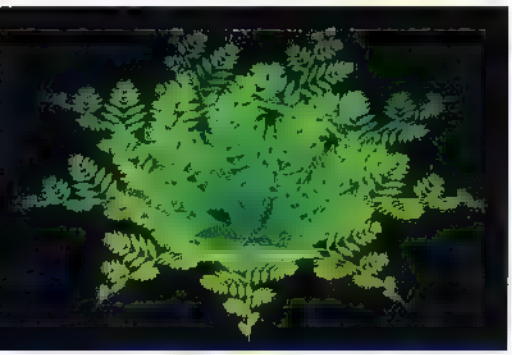
How marvelous, I thought. *Another being that can produce vibrations as substantial as the ones I generate myself.* But I must confess that I was hurt by this being. Whenever the entity made its wondrous sounds, I tried to beam it with all the harmonics my crystalline structure could produce. But it never answered me directly. Perhaps it just didn't really like me.

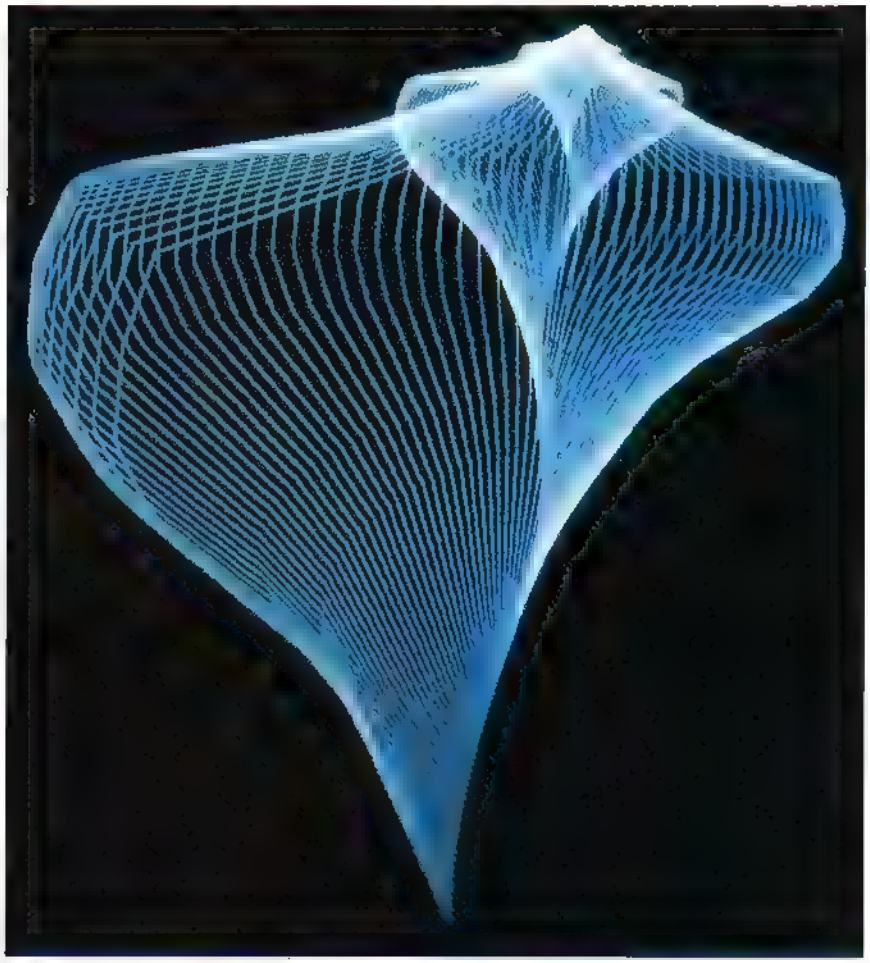
Soon after, with no warning, I was lifted up and moved. The experience of this motion, which I had never felt before, was breathtaking. I was subsequently placed inside a dark case, and when it was opened I could tell I was in a large room filled with organic life forms similar to my maker. He was there, too. For I could feel the vibrations of his tedious, droning voice: "My dear colleagues, you have seen hundreds of slides and dozens of charts as well as the actual life form in the box on the podium

"Can clay breathe? Silicon breed? A-lifers are constructing actual critters, entities that consume energy, emit waste, and even grow."

before me. This structure of calcium eats and grows and undulates. It exhibits circulation and respiration and even crude reproduction, spawning buds that turn into others like itself. It obviously imitates the forms, the colors, the textures, and even the microscopic structure of organic life. Whether it is, in fact, alive is something about which we can only speculate. But the thing from which it came had a period of youthful vigor, of old age, and of death and decay."

Death? Decay? It took me many months to realize the meaning of those words, but when I did, I could not believe it was true. Was I the child of a parent now long gone? Would I die, too? The despair I felt was wrenching, for I had come to love the melodious hum of the geosphere, the stars I sense at night, and even the drone of my maker's thoughts, which give me comfort though they are dull.





The inner musings of entities like this calcium creature were once the stuff of grade B movies. But today an eclectic band of researchers—including computer scientists, biologists, chemists, physicists, and even philosophers—are bent on making the fantasy of artificial life come true. Their creations—known as artificial life forms, or ALFs—are, quite simply, creatures that follow all the rules and patterns of the living, though they are made not of biological material, but of silicon, calcium, and clay.

Some of the scientists—affectionately

called A-lifers—are constructing actual critters, entities that consume energy, emit waste, and even grow. Others are modeling the fundamental concepts of evolutionary biology in complex computer-based ecosystems. In the here and now, these computer models will help scientists study how living beings interact with their environment. In years to come, they may enable A-lifers to design the future-brown societies they hope their ALFs will one day form.

In the foreseeable future, A-lifers say, their myriad creations might include waves of predators designed to rid society of its parasites and pests; artificial pets far more suited to urban lifestyles than today's dogs and cats are; and an endless march of scut workers groomed for dangerous jobs in mines or along the ocean floor. The toughest ALFs—able to survive without oxygen in zero gravity, capable of enduring scorching heat and absolute cold—might explore the farthest reaches of space.

Eventually, some pundits suggest, ALFs

Welcome to the Wookie Bar (preceding page), A-lifer Peter Oppenheimer's visions run an unearthly gamut (clockwise from left): the artificial athlete Wally, the nuclear whale, hors d'oeuvres in orbit, and Mickey Moose. This page, top right: Oppenheimer used mathematics to fashion this conch shell. Canadian researcher Przemyslaw Prusinkiewicz created flowers (above and right) that "grow" in accordance with the life cycles of real flora.

might exist not just because of us but out of an impetus of their own. "I see what's going on now in artificial life research as much more significant than the first printing press, the invention of air travel or anything else that human beings have done since they got going," says J. Doyne Farmer of the Center for Nonlinear Studies at New Mexico's Los Alamos National Laboratory. "We'll be the first species—at least on Earth—to directly create another species, maybe even our own successors."

The full force of the A-Life revolution won't be felt for decades, but the first shots were fired during the field's recent inaugural conference at Los Alamos National Lab. There, in late 1987, man-made crystals grew in serpentine, eerily biological patterns. Artificial living membranes made of inert chemicals took in nutrients and expelled wastes. Roboticists did their stuff. One A-Life was a cat able to meow and fetch. Using computers as an artificial biosphere, some programmers had even created entire ecological systems, including mock environments populated by artificial plants, animals, and worms.

The first rudimentary efforts to actually build a being from the inanimate go back to the eighteenth century, when craftsmen constructed clocks with dancing figures and chirping birds. One particularly ambitious individual created a mechanical duck with 400 articulated linkages in each wing. It quacked, stretched, ate, digested, and, even evacuated, producing an "artificial" stench that contemporaries declared absolutely unbearable. These old automatons, of course, were merely elaborate toys. It wasn't until the twentieth century that researchers on the forefront of the computer revolution began suggesting that they might be the ones to finally re-create life. In the Seventies, at places such as Carnegie-Mellon University, Stanford University, and the Massachusetts Institute of Technology, computer whiz kids created programs that beat champs at chess and robots that could—sort of—see and feel.

Artificial Intelligence (AI) experts at Stanford University and elsewhere even managed to create a series of expert systems—programs that contain the expertise of some human being. Constructed by a computer scientist who has picked the experts' brains and compiled a large collection of rules in a given area of knowledge, an expert system can dispense invaluable advice. Today there are literally hundreds of expert systems in a wide range of areas, including mineral prospecting, medical diagnosis, fighter pilot assistance, even the running of a factory that manufactures concrete. One system, a so-called psychiatrist, helps clients sort out their feelings and their very lives.

But as A-lifers pondered the essence of computers, they realized that present-day AI just barely embodied the principles of life. Even sophisticated expert systems, after all, captured only rote memory—intelligence in its basest form. Expert systems could neither solve novel problems nor pose original questions. Nor were they aware of their own existence.

Carbon-based organisms—biological forms made with protein-like organic chains—had a whole different set of traits. Without exception, they were born, grew, reproduced, and died. They also evolved, which is to say that traits governed by genes changed from generation to generation as the forces of natural selection decreed which qualities were most likely to survive. As a corollary to this, biological organisms even mutated, every now and then creating a more successful candidate for survival in the classic Darwinian mold. They also interacted with their environment and one another, taking in nutrients, for instance, and excreting waste. Finally, biological life possessed the trait of "emergence"—a state in which unexpectedly complex wholes emerged from collections of simple initial elements. This phenomenon crops up whenever bees build a hive, sperm and egg develop into a person, or brain cells interact to make thought.

> *"A mechanical duck with articulated linkages in each wing could quack, stretch, eat, digest, and evacuate, making an "artificial" stench contemporaries found absolutely unbearable."*

These basic definitions of life have caused A-lifers to argue that being is not really a thing but rather an organization—a system that orders random matter in a specific way. As long as it follows certain patterns and rules, they say, any sort of thing could be alive: a batch of chemicals, traffic patterns, a collection of electronic impulses moving through computer chips. All that counts is that these materials—whatever they may be—have the right organization, the right logic. "Life is not a substance: there's no living material'," says Oxford University biologist Richard Dawkins, author of *The Blind Watchmaker*. "It's just an incidental fact that real living things happen to be made of organic soft squishy stuff."

University of Glasgow chemist Alexander Graham Cairns-Smith had these concepts in mind not long ago when he suggested we might make some of the first A-Life from, of all things, clay. Back in 1985 Cairns-Smith and San Jose State University chemist Lelia Coyne, working independently, announced insights that contributed to a controversial new theory that organic life had evolved not from a cauldron of primordial soup, as had long been thought, but from clay. Clay could store energy from the environment and transfer it back to organic molecules, which in turn would follow the patterns of the clay to live and reproduce. This unique ability enabled clay to form the matrix for biological life soon after the earth was formed.

Today Cairns-Smith takes that theory further still. Not only can clay give rise to organic life, he says, it may also be able to reproduce itself. One lifelike virtue of clay, for instance, is that it can transmit information—something done by living biological organisms through their DNA. When a new clay crystal forms on an old one, the "child" often incorporates the distinctive, individual electrical and structural characteristics of the "parent." If the new crystal flakes off and goes its separate way, the individuality and distinctiveness of the parent may live on in its progeny.

Once formed, notes Cairns-Smith, these clay crystals can actually undergo natural selection and evolve. For instance, he says, imagine a situation in which big crystals of clay made more big crystals while small crystals made small crystals. "One could picture these crystals at the bottom of a streambed, perhaps, where to be small is to be successful. The small crystals might predominate, and the big ones might eventually die out."

Finally and perhaps most important, clay can interact with its environment. Its reactive surface plays host to myriad chemical reactions necessary if a structure is ever to absorb nutrients, excrete waste, or breathe. What's more, clay forms membranes letting it interact with the environment without getting swallowed up. "The environment is a kind of stream," Cairns-Smith says, "and the organism a kind of turbulence in that stream. Membranes are essential if this turbulence is to maintain its integrity and stay in one piece."

But does this mean clay is alive? Or that in the future we can use it to fashion life forms of our own design? "Clay is a hardy form of 'low-tech life.'" Cairns-Smith believes. "Biological life is high-tech. It is more productive and varied but also more vulnerable to environmental stresses and far more complex. Surely," he adds, "there must be a more general sort of biology than the one based solely on DNA."

Cairns-Smith isn't the only A-lifer to dream of structuring A-Life from inorganic stuff. Fordham University systems scientist Milan Zeleny has recently had the outrageous idea of making a creature out of calcium chloride. Actually, Zeleny's endeavors emerge quite naturally from his field of study itself. As a systems scientist, he was interested in studying the basic phenomena of organization and complexity. And during his readings, he happened to stumble across some fascinating work on complexity by the great French chemist and physician Stephane Leduc.

CONTINUED ON PAGE 164

SIX FLIGHTS OF FANTASY

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URBAN RENEWAL By T Coraghessan Boyle

Sanni Abubakar was on his knees "Please, sir, this is ungodly living This is lustful and degrading We must put an end to it"

I was wearing a fez They'd brought me in as urban affairs adviser to the governor, a weak-chinned fop of a man who spent his days chewing khat and dawdling with his wives My desk, carved from a single piece of bongo wood, weighed over three hundred pounds There was no limit to my power within the walls of the city 'Yes, Sanni," I said, my voice drenched with benevolence

Sanni was a hard little rubber ball of a man, roughly the shape and color of an eggplant He was the intercessor between me, the governor, and the local people's councils He was forever in a dither about something The first day I arrived from Century City—before I even had a chance to try on my fez—he was tugging at my sleeve, harping about twigs Twigs As if I didn't have enough to worry about, what with the swooning deadfall of the plane as we came in over the desert, the lingering queasiness from my fresh inoculations, and my forthcoming meeting with the governor Here I was, absolutely skewered with exhaustion, and Sanni was worried about twigs "What's the problem?" I'd asked him

'Wood, sir The people don't have any wood for their cooking fires"

I was an innocent back then "Well, why can't they go outside the city to find it?"

"Oh, they do, they do," Sanni crooned "That s the problem. The nearest source of firewood is over eighty miles away, in the Tahat Massif Thousands make the trek over the sand for a bundle of sticks then they sell the sticks back here for two American dollars apiece No one can afford a hot meal

"Ah" I said, and my first thought was this cold cereal Suddenly I saw them all—every last basket weaver goatherd and jitney driver in town -hunkered over bowls of Rice Chex, Special K Froot Loops But then I checked myself What, after all, was the nutritional value of Froot Loops? Roughly the same as eating the box in which they're packed, I supposed—and that would never do

So then—and was exhausted remember I hit on sushi What could be better? Nutritious, low in cholesterol, and it requires no cooking not a single blessed two-dollar twig "Sushi, Sanni," I said, "sushi"

He gave me an odd look, as if struck dumb with the brilliance of the idea "Sushi?" he said.

I could see it already if they'd taught me anything at the Sequoit School of Design and Urban Planning, it was to be flexible was suddenly and dramatically expanding my vision of the downtown urban redevelopment project to include a Japantown thirty or forty sushi bars with gleaming black marble counters, slow fans and paper anterns Uni, Spanish mackerel and quail eggs Wasabi Sake I was hot, I was excited I'd been on the ground less than two hours, and already I'd resolved my first major crisis But now it was something else. Every day it was something else. Camels

defecating on the trees in the new Banni Said Ben-Banni Ban Tower Plaza, lepers congregating in the tanning salons (in their ignorance, their barbarity, they nurtured the fond hope that the ultraviolet rays would cure them), skinks coming in off the desert by the millions to throw themselves into the reflecting pools at the AramCo Center Pavilion. And now this. "Yes, Sanni," I repeated, "selling their bodies, you say?"

He took me by the arm. I had to see this myself, he insisted. As we left the offices I'd personally designed—iridescent sea-green panels in a twenty-seven-story tower with a massive Oldenburg in the atrium—Sanni filled me in. It was the drought, he said. Whole families were coming in from the countryside because their crops had failed because the seasonal grasses were too sparse to support their goats and kids. But it wasn't just the drought, it was the bright-lights, big-city syndrome, too. Why sit counting your toes on a goat-hair carpet in the middle of nowhere when you can play Space Invaders in the umbrageous hollows of the video arcade or stroll along the unmoving belt of the PeopleMover, contemplating a time when the authorities will throw the switch and put it in motion?

The problem was, these people had no money. No money for sea urchin roe flown in from the Benihanas in Rome or for chocolate egg creams concocted in the Soft Rock Café on the Faisal Mezzanine. No money for food of any sort. Or lodging. They were crowding the pristine sidewalks of the Boulevard Rodeo Drive and littering the steps of the Wells Fargo Building. In desperation, they'd turned to selling their own daughters.

I was no longer a babe. I'd been living in the city for almost four years now and had seen my most daring dreams come to fruition, tangibilized in stone and steel and plastic and glass. I knew a whore when I saw one.

We stepped out onto the boulevard, the sun cutting at my eyes like a knife, and there they were. Dark-eyed, slim toothless, in their leather miniskirts and fishnet stockings. "Want a date?" they murmured as we strode by, Sanni and I arms linked, like two old codgers on the Santa Monica Pier. "A date a date, the voices whispered as we ducked into the cool depths of Edo Sushi.

The place was deserted. The people hadn't really taken to sushi, peeling off the shrimp and scallops and pink glistening morsels of Norwegian salmon and feeding them to their dogs and goats. They'd never seen a fish before, and their holy book had warned them about eating uncooked flesh. For a while they'd been enthusiastic about the rice balls, but even that was short lived. Mohammed, our sushi chef, greeted us. He wore a white kung fu sash round his head, and the Arabic characters on his robe seemed a reasonable substitute for the ideographs of the Land of the Rising Sun. "What's happening?" he asked with a grin.

Sanni replied warmly ("The tubes, man, the tubes"), but I merely shrugged, distracted by the problem at hand. We couldn't have our new city streets looking like the corner of Hollywood and Vine—I'd torn down ten square blocks of calcified mud hovels and the odd mosque or two to achieve a kind of Brasília-in-the-desert effect, and I was damned if I'd have it spoiled by all these beggars and their butt swishing whores.

I turned to Sanni. He was negotiating his nigiri platter warily, the plastic chopsticks (we'd tried wood originally, but people kept stealing them for their cooking fires) hovering uncertainly over a slice of tuna that looked a bit tired round the edges. "Do you think they'd go back to their villages if we put an end to the prostitution problem?"

Sanni seemed almost relieved to set down his chopsticks. He sniffed suspiciously at his cup of green tea and threw it back in a gulp as if he were a cowhand quaffing cheap whiskey. He gave me a gap-toothed smile. "I think maybe so."

"We ducked into Edo Sushi. The place was deserted. The people hadn't taken to sushi. They'd never seen a fish before, and their holy book warned them about eating uncooked flesh."

For a long moment I kept him in suspense, while the look of wisdom I cultivated in the mirror crept over my face. I laid the chopsticks carefully across the wasabi dish, adjusted my fez, and let my voice rise in a melodious wave. "Our new edict reads as follows: 'A single females within the city limits must be married by next Tuesday, noon. Noncompliance will result in banishment to the Tahat Massif, there to gather wood in perpetuity.'"

Sanni looked stunned. "Oh, sir," he said clapping his hands, "this is wisdom."

As it turned out it wasn't so wise after all. Everyone got married—there was no problem with that. In fact, for a while there my glittering city began to look like Las Vegas, what with the marriage brokers setting up in every spare office and doorway, catfights breaking out over prospective husbands, the streets alive with the mumbo jumbo of haggling and bidding and counterbidding. The governor himself—Banni Said Ben-Banni Ban—found it in his heart to take some sixteen new wives into his fold, the Mercedes dealer and Haagen-Dazs distributor took on a few more each, and even Sanni showed up one afternoon in the company of two dark pubescent beauties who flaunted almond eyes and tribal cicatrices. One of my staffers—an otherwise competent fellow in the Redevelopment Offices—even came to me and timidly submitted that he was thinking I might take a daughter or two off his hands. Well the fact is, I don't swing that way, and I told him as much in so many words.

Within the week every unmarried girl in town above the age of twelve had found a husband. The discouraging thing though, was that it didn't make a lot of difference. Married or not, they still loitered round the stalled PeopleMover exits, beneath the canopies of the sushi bars, and on the steps of the office buildings dressed like outer space aliens and selling their wares as shamelessly as before. I was frustrated, I admit it. Here I'd created this artwork of a living space, this glowing canvas of a city, this monument for them to live in, and their own petty needs and wants were destroying it. For a time there I just wanted to turn my back on the whole business and go home to Wilshire Boulevard and the Avenue of the Stars. But I was no defeatist. *Be flexible*, I told myself, *be loose, be creative. There's got to be a way.*

Two days later I had it.

I summoned Sanni and Sidi Ambak Bubi, my Parsons-educated minimall expert, and took lunch with them at the Soft Rock Café. I had the guacamole burger. Neither Sanni nor Sidi was hungry. "I'm willing to admit my mistakes," I said, dabbing guacamole from the corners of my mouth, "and to learn from them." Soft rock hummed through the big overhead speakers, the volume so low it was nearly indistinguishable from static. "Ones designs do not exist in a vacuum," I said. "To implement them and be truly successful one must make allowances for the local culture. I see that now."

Sanni nodded sagely. He remained obeisant, but could see that at a stroke I'd gone down a notch or two in his esteem—the women were still in the streets, plying their ungodly trade, and it had to gall him. Not to mention the two new wives he had to feed. I cleared my throat, took a sip of my egg cream. "What I'm trying to say is this: minimalls."

Sidi, who'd been drifting off to the barely detectable strains of "I Want to Hold Your Hand" (the Mantovani version), sat upright.

"If we can't eliminate the prostitution problem at least we can disperse it. What do you think?"

"Frozen yogurt," Sidi said. "Polo Gordo. House of Siam. A one-stop cleaners. 7 Eleven."

A slow smile lit Sanni's face. I could see I was restored to his pantheon. I gave it a beat, then I said: "Yes. The city will have its suburban spraw and its convenience stores, minimalls advancing into the dried-up countryside itself, but there's one thing I insist on." Sidi cupped his beard in his hands, Sanni leaned forward.

"In each minimal, no matter how busy or how high the rents, no matter who we get to anchor it—7-Eleven, Stop N Go, Shakey's—there's got to be one store devoted to one item alone."

"Yes?" Sanni said. "And what would that item be?"

Burgers were sizzling on the grill. Somewhere on the periphery of my consciousness I was aware of Barry Manilow limping through a string-infested version of "Stairway to Heaven." I grinned. Flipped back the tassel of my fez. "Simple," I said, the resonance of sagacity filling out my voice till it sounded as if I were speaking through a trumpet, "twigs."

THE STADIUM

By Joyce Carol Oates

There was a man, no longer young though not yet old, who, traveling alone in northern Europe, began to feel that his soul was being drained slowly, almost secretly from him, drop by drop. He woke frequently in the night, in unfamiliar hotel beds, his eyes opened wide and sightless, his damp hair stuck to his forehead. In the northernmost city of his itinerary, where, at the summer solstice, the sun barely set, and the sky was eerily illuminated through the brief night, he knew himself close to oblivion. *Why am I not more frightened?* he wondered. Much of his life had been passed in a careful, civilized sort of fear, always under control. He had made this fear, and his control of it, more or less his life's work, his art. Yet now, alone, his senses alert to the point of pain, he was scarcely afraid at all. He supposed it had something to do with the unnatural fading of the night.

In the morning he stood shirtless at a window of his hotel room, observing the sky, which was a faint marbled blue, radiant with Arctic cold. He drew a deep breath and trembled with a sensation very like bliss. *Why so happy?* he wondered. He felt, in that instant, that all of his life, his true life, still lay before him.

Though later that morning he would be obliged to give a lecture at the university before an audience of several hundred people and must dress the part, in expensive, custom-made suits—for he was, in his public self, a "distinguished" man—now he put on old clothes, running shoes, a woolen hat, and gloves. He left the hotel and went to run in an enormous civic stadium that had been pointed out to him the day before by his translator. The air was fresh and alien to the taste, blindingly bright, the wind so percussive it took his breath away.

The stadium, built within the past few years, already looked to his eye, disconcertingly shabby. Its walls of poured concrete rain streaked as if tear streaked, its walkways narrow, with a pervasive odor of damp and of something more malevolent, like backed up drains. Grit encrusted weeds poked their way like evil thoughts, through cracks in the pavement. And the size of the stadium, for which he should have been prepared, was really quite . . . disconcerting. Rows of seats, empty seats, lifted above him and behind him, on all sides, the space was the size of a small city. Approximately half the seats were exposed in the harsh sunshine, and half were obscured in shadow that appeared too dark to be, at this time of day, altogether natural. And the cinder track, which should have been no more than a mile long, stretched nearly out of sight, a foreshortened and distended circle.

He wondered suddenly why he had come to this place, what force had drawn him. But of course it was too late to turn back. He pulled the woolen cap down low on his forehead and began to run.

And began to hear, almost at once, at his back and rising vertiginously overhead, a low, murmurous sound, as of a great crowd. He could feel its collective anticipation, its very nearly palpable excitement; he could hear the humming of the amplifying system, the small black cinders crunched beneath his hard-driving feet with a faint air of protest. The thought came calmly to him: *Here are fine-ground bones, preceding yours.*

Still, he ran. A small, solitary figure, he ran.

WEMPIRES

By Daniel Pinkwater

I saw a movie on TV one Saturday afternoon. It was about a vampire. What a good movie!

The vampire was scary. He was real smooth. I liked his clothes. I decided I would be a vampire. I asked my mother to help me make a vampire costume.

"But Halloween is three months away," she said.

"Just the same," I said. "I'd like you to help me make the costume. Please." Actually, she made the whole thing. It was very good.

I smeared my face with white stuff my mother uses at night, and I rubbed my hair with salad oil so it would be shiny and smooth. I used a little red lipstick. I looked good.

Then I waited in the hallway for my sister to come by.

It's fairly dark in the hallway.

It was a big success.

I turned up at supper in my vampire suit. Everybody thought it was cute. My father took pictures. Every time I looked at my sister she burst into tears. I practiced doing vampire moves and saying

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vampire things. The first problem came the next morning. They wouldn't let me wear my vampire suit to school.

"None of the other children go around wearing capes," my mother said.

"That's because they don't have any," I said.

"Look, you can't go to school dressed like a vampire."

"Why not?"

"Because I'm your mother and I say you can't. You may put on your vampire suit when you come home."

"Could I sleep in a coffin, do you think?" I asked.

"This is getting weird," my mother said.

After school I went to the dime store and got the one thing I really needed: fake plastic vampire teeth.

The next day my teacher sent a note home with me.

Dear Mrs. Harker:

Jonathan has been threatening to bite children in his class. I have asked him to leave his fangs at home. I hope you will have a little talk with him.

Yours truly,
Mildred Van Helsing
(Teacher)

My parents had a little talk with me. They said that they thought I would get tired of being a vampire. They said I could wear my cape and fangs and things around the house, but I was not to dress or act like a vampire at school.

I'll never get tired of being a vampire, I thought.

My parents also said that if I didn't cooperate, they would take steps.

"What steps would you take?" I asked.

"Steps," they said. "Just go to your room and think about it."

I went to my room and cut out bats. I hung them from the ceiling on pieces of thread. They looked pretty good.

That night, when I was sleeping, vampires came through the window.

I woke up.

"Hallo, Sonnyboy!" the vampires said. "How's by you?"

"Wait a minute!" I said. "Are you guys vampires?"

"Wempires! That's us!"

"Real ones?"

"Of course real! What did you think, fake wempires?"

"And you can turn into bats?"

"Anytime we like."

"And you—uh—drink people's blood?"

"Phooey! What a disgusting deal! Where did you hear that?"

"Everybody knows that," I said.

"Phooey! From television you get such ideas. Drinking blood—ych!" said the vampires. "Now for drinking, ginger ale is best. Maybe you have some ginger ale in the house?"

"There might be some in the icebox."

"And chicken. Chicken we eat."

"There might be some cold chicken."

"Cold chicken is good. Let's go down to the kitchen, Sonnyboy. Don't make noise and wake up the family."

The vampires followed me down the stairs to the kitchen. There was most of a cooked chicken in the icebox and the vampires found two big bottles of ginger ale. They ate the chicken and drank a lot of ginger ale. Then they burped.

"Hey, Sonnyboy! Do you got any onions?" they asked. They opened cans of sardines, toasted slices of whole wheat bread and made sardine-and-onion sandwiches.

When they had finished those, they poured cornflakes into bowls and sloshed milk over them.

The vampires were making a mess of the kitchen. They were having a good time. They sang a song.

"Sing the song with us, Sonnyboy!" the vampires said.

"I don't care for peaches. They are full of stones.

I like bananas because they have no bones."

All of a sudden my mother was standing in the doorway. She was wearing her bathrobe.

"What's this? Vampires in my kitchen in the middle of the night?"

"Hallo, Sonnyboy's mother," the vampires said.

"There are crumbs everywhere," my mother said.

"We having a party," the vampires said.

"Out," my mother said.

"Out?" asked the vampires.

"Out now," my mother said.

"Well, good-bye, Sonnyboy," the vampires said. They climbed out the kitchen window.

"I didn't know they would mess up the kitchen," I said.

"Now do you see why your father and I didn't want you to behave like a vampire?" my mother said.

"They didn't mean any harm," I said.

"Go to your room."

I went to my room. I looked out my window. The vampires were making their way down the street. They waved to me.

"Good-bye, Sonnyboy! Be a good wempire!"

What neat guys! Nothing will ever change my mind about being a vampire.

HOP SKIP JUMP
By Barry N. Malzberg

In the distance Constanza thought she could see the Battery, the extreme southern tip of Manhattan with boats prowling the waters, the thin lights and suggestion of ships curving toward the night, nearer were the heavier, blooming lights of midtown Manhattan, the suggestion of motion within. But in the tight confinement of the car itself, looking at the George

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ARTICLE

LEE COUNTY'S LIZARD MAN AND OTHER UNSOLVED MYSTERIES

BY DENNIS STACY AND KEVIN McKINNEY

Scientists who solve mysteries are often awarded academic accolades and Nobel prizes; amateur anomalists receive a footnote in history books at best. To explain the origin of the universe, for example, Belgian priest Georges Lemaître proposed the idea of a "big noise." The explosion of a single mass of material, he suggested, sparked the creation of the universe, which has been expanding ever since.

Changing the theory's name to the more alliterative "Big Bang," astronomer Fred Hoyle dismissed Lemaître's idea as preposterous and challenged it with his own. According to Hoyle's steady-state theory, the universe has always existed and has always been expanding. Today, however, astrophysicists, who study the universe and its origins, have strengthened the argument in favor of the Big Bang theory.

Some mysteries, of course, are eventually explained, proved to be hoaxes, or otherwise declared invalid. Take, for example, the human footprints discovered alongside dinosaur tracks in a Glen Rose, Texas, riverbed. Here was proof, creationists argued, that dinosaurs and man had lived at the same time—an idea long disputed by scientists. Examining the site in minute detail, however, computer programmer and amateur dinosaur detective Glen Kuban eventually found faded bluish-gray and rust-colored stains that indicated the "human" prints were actually dinosaur toe prints. Kuban not only discovered no evidence of human–dinosaur coexistence but also caused paleontologists to reexamine their ideas of the stance and posture of dinosaurs.

"The principal summons of knowledge is a desire to solve mysteries," Albert Einstein once said. Fortunately for both the amateur and the professional Sherlock Holmes, there is a bounty of unsolved mysteries—old and new, large and small—to keep us occupied until the year 2000 and beyond. The following cases are just a few that may be resolved one day by anomalists if not by scientists—perhaps even by you. Most of them—some hundreds of years old, others having cropped up, in one form or another, just this year—raise intriguing and unsettling questions. But what do they all add up to?

As you read our case histories—nine from the *Omni* files and a new one to be submitted by you for our Backyard Baffler contest—ask yourself, Should scientists devote attention to these mysteries? Why? How will knowledge about any one of them benefit us today—or tomorrow? And what speculations, moreover, do you have about their origins, causes, or purpose?

PAINTING BY ROBIN MULLER

We'd like to know your opinions. Send them to Mystery Forum, c/o *Omni*, 1965 Broadway, New York, NY 10023-5965. (Be sure to mail your comments separately from your Backyard Baffler entries.)

FILE #1803-SC
THE LEAPIN' LIZARD CASE

DESCRIPTION. Scape Ore Swamp, outside Bishopville in Lee County, South Carolina, is said to be haunted by a seven-foot-tall Lizard Man with green, scaly skin and red eyes. According to startled eyewitnesses, the creature has only three toes on each foot, as well as long, apelike arms that end in three fingers tipped with four-inch claws.

WITNESSES. Around two A.M. on June 29, 1988, seventeen-year-old Chris Davis stopped near the swamp's brackish waters to change a flat tire. While replacing the jack in the car's trunk, Davis says, "I looked back and saw something running across the field toward me. It was about twenty-five yards away, and its red eyes were glowing."

Davis jumped back into his 1976 Toyota Celica, only to engage in a tug-of-war with Lizard Man as he tried to pull the door closed. "I could see him from the neck down—the three big fingers, long, black nails; and green, rough skin," Davis claims. "And he was strong."

Davis is the only true eyewitness, although everybody seems to have a Lizard Man tale to tell. Teenagers Rodney Nolfe and Shane Stokes, for example, say Lizard Man darted across the road in front of their car and "into the swamp where Interstate 20 meets Highway 15." And construction worker George Holoman claims he encountered the creature while drawing water from an artesian well.

"Lizard Man also appears to have a ravenous appetite for McDonald's fish sandwiches," says cryptozoologist Erik Beckjord, founder of the National Cryptozoological Society, which investigates sightings of seemingly mythical creatures. Making its home in the swamp, the creature may have been hungry and attracted to Davis's car because it was loaded with the sandwiches, as well as with hamburgers and French fries. "With the drought affecting their food supply, bears have gone after picnic baskets in Yosemite National Park," Beckjord says. "Lizard Man and other Bigfoot creatures may also be victims of the drought."

EVIDENCE. Following the Nolfe–Stokes sighting, state trooper Mike Hodge and Lee County deputy sheriff Wayne Atkinson investigated the area. They found three crumpled 40-gallon cardboard drums. The tops of saplings were ripped off—eight feet above the ground. There were also, according to Hodge, "humongous footprints," fourteen by seven inches, impressions in hard red sand.

Following the tracks for 400 yards, the law enforcement officers backtracked and found new prints impressed in their car's tire tracks. "Whatever it was, it had already walked back across where we had been," Hodge says.

SUSPECTS. Davis's account matches most other Bigfoot descriptions except for the green skin. According to Beckjord, the creatures are usually very tall, red-eyed, hairy beasts with five digits on each hand and foot.

"Lizard Man is only the second sighted Bigfoot to have three fingers, and he's the first to have only three fingers on each hand *and* three toes on each foot," he says. "That makes him the rarest, the most unusual Bigfoot ever encountered."

SUMMARY. Lizard Man has become a Bishopville tourist attraction. Vendors have hawked souvenirs, and guides have offered tours of the swamp. There's even a "Lizard Man information center" at an Interstate 20 truck stop where Davis has autographed Lizard Man T-shirts.

Columbia, South Carolina, radio station WCOS, moreover, has offered a $1 million reward for the capture of a live Lizard Man—if it turns out to be a previously unknown animal.

"Davis stopped near the brackish waters to change a flat tire. While replacing the jack in the trunk, he looked back and saw something running toward him. Its red eyes were glowing."

RECOMMENDATION. Bigfoot sightings tend to continue for a while and then suddenly cease—until someone claims to have sighted a Bigfoot in another area. Beckjord has urgently suggested that *Omni* sponsor his expedition in search of Lizard Man. "The sooner the better," he says. "If you wait too long, he will have headed for Alabama or somewhere else."

Caution advised. One man who claimed to have shot at Lizard Man produced a bloodstained napkin and "scales." Although he later admitted it was a hoax, somebody could be seriously injured before the publicity dies down.

FILE #5000-H2O
THE TWO-BY-TWO CASE

DESCRIPTION. A seafaring vessel made of gopher wood, probably rectangular in shape and measuring roughly 515 by 85 by 50 feet, depending on the equivalent cubit measurements. Cargo: "every living thing of all flesh, two of every kind." Through the efforts of family patriarch Noah, guided by the Great Architect's blueprints, this ark was built to weather severe floods more than 4,000 years ago. Among its other abilities, the ark would have been able to battle 200-foot waves without taking on any water.

When the waters receded, the craft was allegedly beached in the mountains of Ararat, a vast area in eastern Turkey near the borders of Iran and Soviet Armenia.

EVIDENCE. Former astronaut Colonel James Irwin, who has made nearly annual expeditions in search of Noah's ark since 1982, isn't certain that the ark is actually on Mount Ararat. "The Bible says only that the ark came to rest in the mountains of Ararat," he says. In fact, he points out, in the lava flow there is an impression of a vessel with almost the exact dimensions of Noah's ark." The "impression" is actually a large mound covered with ice and snow. Los Alamos, New Mexico, geophysicist John Baumgardner's opinion on this is still unknown. He has gone to the mountain to investigate the site and therefore has been unavailable for comment.

Arkologist Robert Cornuke, an associate of Irwin's, flew over the same area this past summer and reported sighting a large dark gray section. It contrasts with the surrounding high valley area known as Ahora Gorge. "The coloring, nearby running water, and other details match eyewitness descriptions over the years," says Cornuke, who is vice-president of High Flight Irwin's nonprofit Christian organization in Colorado.

Convinced the Ahora Gorge mound is the ark, arkologist Ron Wyatt explains that the vessel's measurements are described not in feet but in cubits, a unit whose lengths varied from tribe to tribe. "Using Egyptian arithmetic, which Noah would have known, he says, the ark's three-hundred-cubit length would be equivalent to five hundred fifteen feet." Wyatt conjectures that the 30-cubit-high sides of the ark collapsed at some point. Its flattened sides and 50-cubit width would measure 110 cubits. The measurements of the dark gray section in Ahora Gorge: "three hundred by one hundred ten Egyptian cubits," Wyatt says.

SUMMARY. Ararat sits in a politically sensitive corner of Turkey. Avalanches and earthquakes also act as deterrents to potential investigators. The climbing season, moreover, is short—the mountains are covered by snow and ice for most of the year.

RECOMMENDATION. Follow up on the results of Baumgardner's research.

If however anyone else wants to go to the mountain, Wyatt recommends that you stay at the Hotel Simeri in Dogubayazit (pronounced "do-buy-sit"), four hours by bus or taxi from Erzurum. But go to the Oral Hotel, he adds, and ask for a cabdriver named Derayar Avci. Tell him, "*Gemitash*," and he will take you to see the "boat stone."

FILE #9000-BC
THE CASE OF LAND DOWN UNDER

DESCRIPTION Atlantis -a k a Attli, Attala, Aztlan and other similar names depending on the cultural origins of the stories was a large landmass, possibly a whole continent It allegedly sank 11,000 years ago during a phenomenal catastrophe. Atlantis was last seen somewhere in the Atlantic possibly between Europe and North America, maybe even connecting them Then again maybe not The details aren't very specific

WITNESSES The modern case for Atlantis has its roots in the testimony of Greek philosopher Plato and is taken from two of his printed dialogues with Critias and Timaeus The text refers to Athenian lawmaker Solon's opinions on the subject The veracity of Plato's, or even Solon's accounts, for that matter, is undetermined at this time.

SUSPECTS Plato refers to a catastrophe that took place roughly 9,000 years before. If either he or his translators added an extra zero, however, the event would have occurred approximately 900 years before This would make the Mediterranean island of Thira, also known as Santorin, a likely candidate as the site of Atlantis Indeed, excavators have found ruins of the Minoan civilization destroyed during a volcanic eruption that triggered gigantic tidal waves in 1470 B C

Investigators who take their Greek literally argue that Atlantis must be where Plato said it was beyond the Pillars of Hercules, or modern day Gibraltar Consequently the Azores, a lonely beacon of islands west of the Iberian Peninsula have been the object of much Atlantean speculation In 1979 Andrei Aksyonov deputy director of the Soviet Union's Shirshov Institute of Oceanography, believed his research team had found ruins of ancient stonework on the submerged volcanic mountain of Ampere, one of several peaks in the sea-bottom range arching from Portugal's coast to northern Africa Study of the photographs seemed to dispel the theory, however The vestiges of walls and staircases," Aksyonov said were merely geologic formations formed by volcanic action

In the late Sixties amateur explorers discovered what they thought were cyclopean pavement stones beneath the waters off the Bimini coast Like those at Ampere, these could eventually prove to be the result of natural activity The site remains one of several possible candidates however, according to archaeologist Gary Stickel who is mounting an expedition to the area. "Our goal is not to prove that the site is a portion of Atlantis but rather to determine whether the formation detected beneath the waters is, in fact, an archaeological site,' says Stickel who was involved in developing the character of the fictional archaeologist Indiana Jones.

A strip of submarine stair-stepped stones, similar to the Bimini and Ampere formations has also been discovered near Lanzarote, one of the Canary Islands "There are more than two hundred seventy-five theories on the location of Atlantis, nearly half of them indicating the Atlantic, others suggesting such places as Spain Africa, North America, the Netherlands and even Mecklenburg, [East] Germany,' says author Charles Berlitz a student of ancient history who still seeks the mythical continent

'Atlantis was a prehistoric empire, and there may have been many outposts, Thira being one of them," Berlitz says. The Azores and the Canary Islands he adds, were once mountainous regions of the Atlantis mainland

SUMMARY The one thing that can be said with any certainty is that the lost continent will probably not be found in anyone's backyard unless it's a sizable chunk of seashore property And even Donald Trump would have a hard time raising Atlantis from the murky depths

RECOMMENDATION Follow up on Stickel's explorations Periodically check *Earthwatch* magazine for researchers seeking assistance on a planned expedition to Atlantis

"Wyatt recommends that you stay at the Hotel Sim-er, four hours by bus or taxi from Erzurum. Ask for a cabbie named Delavar Avci. Tell him, "Gemitash," and he'll take you to the boat."

FILE #011501 BH
REFLECTIONS IN A CRYSTAL SKULL

DESCRIPTION A number of carved crystal skulls have surfaced within the last century, one most recently popping up in Texas No one knows for certain where any of them came from, exactly how they were made or why" says *Strange Magazine* editor Mark Chorvinsky, the world's foremost authority on crystal skulls

'The problem is that none of them were found during controlled archaeological searches,' adds Anthony Shelton curator of the Museum of Mankind at the British Museum in London Such controls might have enabled researchers to determine a skull's age, for example, from other nearby artifacts or debris

There are many tales told by both believers and skeptics of the skulls' effects on observers Strange visions have been seen within their clear crystal craniums Auras have allegedly surrounded the objects on several occasions And unusual odors have been detected within their immediate vicinity

EVIDENCE There may be as many as 13 authentic crystal skulls including the life size skull on display in the British Museum and two fist size skulls in its catalog Modern replicas have occasionally surfaced Chorvinsky adds

The finest specimen was allegedly discovered in 1927 at Lubaantun ("City of Fallen Stones"), a Mayan ruin in Belize Anna Mitchell Hedges, the adopted daughter of a vagabond adventurer looking for Atlantis, claimed she found the smoothly polished top half of the skull among the rubble near an ancient altar The lower jawbone was supposedly uncovered three months later—nearly 25 feet from the altar The whole five- by seven- by five inch skull weighs eleven pounds and seven ounces

The two pieces were indeed carved from the same piece of crystal but it's impossible to estimate the age of the skull Unlike organic material, rock crystal is impossible to date "Microscopic amounts of water in the skulls could be dated, Chorvinsky says "But to do that you would have to break the skull At some time in the future there might be a technique that will let us analyze the water without physically entering the skull"

Performing a series of optical and chemical tests, British Museum researchers detected a microscopic imperfection in their life-size skull "A master jeweler who studied it expressed the opinion that the flaw could only be the result of having used a wheel in the original cutting process" Shelton says

Researchers speculate that the crystal probably originated in northeastern Brazil. "This crystal was used in the nineteenth century to make crystal balls, for example, that were then exported from Brazil, Shelton says "My guess, then is that the skulls were created in the nineteenth century' If so, he adds, that would still not diminish their value or interest

SUMMARY The crystal skulls could be oracle devices in the manner of Delphi They have been variously attributed to the Aztecs and the Maya, as well as to the legendary Atlanteans This is not likely, however, based on the British Museum's calculations Chorvinsky points out however that "it's an amazing artifact If nothing else, it is certainly a gold mine of myth and speculation'

RECOMMENDATION Additional study required Follow up when more advanced technology is available to date the microencapsulated water

The Mitchell Hedges skull is occasionally displayed at mineral and gem shows as well as at New Age conventions Check newspapers and other notices on such events.

FILE #1570-BE
THE RIDDLE OF BRIGHT LIGHTS OLD CITIES

DESCRIPTION Prehistory company use of electricity may have been more widespread than authorities have suspected Both Babylonian and Egyptian high priests and perhaps even common artisans may have been adept at producing nonmetered electrical energy

Electricity may have been used to electroplate gold on copper vessels and perhaps to illuminate underground crypts and tombs

EVIDENCE As early as 1936 German archaeologist Wilhelm Konig recovered small batteries from Khujut Rabua, a hill of rubble near Baghdad Encased in a terra cotta container, each battery was about the size of a hand grenade At one end the batteries were plugged with a blob of asphalt (the same bitumen Noah may have used to caulk his ark) An iron rod ran through the center of the asphalt stopper, and a four- by one-inch copper sleeve surrounded the rod's entry point The copper was soldered with the same alloy—60 percent tin and 40 percent lead—that's used in today's flashlight batteries Vinegar or wine was probably used as an electrolyte

American engineer Willard Gray replicated the Baghdad battery, filling his version with copper sulfate and attaching wires It produced a one-half-volt current

At Dendera 40 miles north of Luxor, a relief of Thoth, the "giver of arts and sciences" in Egyptian mythology, depicts the god with objects that resemble giant light bulbs with undulating filaments, as well as cables insulators, and generators

SUSPECTS Parthians, who ruled the Baghdad area around 250 B C are presumed responsible for the battery

The Egyptian engineer could be Thoth, portrayed as part bird part human or as half baboon and half stork. Obviously a master of disguises a.k.a. Taaut and Hermes Trismegistus

SUMMARY Since no one has yet been able to interpret the Egyptian reliefs symbolism, "we can only speculate about their possible electrical power" says Helmut Satzinger of Vienna's Kunsthistoriches Museum "The so-called light bulb *could* be the Barge of the Sun, a boat the sun god Ra navigates across the sky during the day and through the underworld at night"

RECOMMENDATION If the ancient Parthians and Egyptians discovered electricity before English physicist William Gilbert did in 1570 no original blueprints have been found

The next time you're in the area check out the battery at the museum in Baghdad For information about the Dendera reliefs and hieroglyphics, before or after visiting the temple, contact the Egyptian Authority for Antiquities facing the police academy in Abbassiya Egypt

FILE #1713-TX
THE CASE OF THE FIERY DIAMOND

DESCRIPTION One of the most horrifying UFO encounters on record occurred in Dayton, Texas near Houston on the night of December 29, 1980 Betty Cash, then fifty-one years old, Vickie Landrum, fifty-seven, and Vickie's seven-year-old grandson Colby Landrum were returning from a bingo game Driving along pine tree-lined rural Highway FM1485, they allegedly sighted a hovering 'diamond of fire' belching flames and emitting air brake like sounds Cash brought her Oldsmobile Cutlass Supreme to a halt and all three passengers got out to take a closer look As they gazed in awe and terror, more than 20 helicopters suddenly appeared and circled the fiery object, trailing it when it finally flew away

Betty Cash remained outside the car longest, until the heat became unbearable When she attempted to reenter the car, the door handle was so hot that she had to grasp it with her coat

"Strange visions have been seen in their clear crystal craniums. Auras have reportedly 'surrounded them on some occasions. And odd odors have been detected within their vicinity."

EVIDENCE The fiery diamond left behind a legacy of illness and suffering that continues to afflict the three victims Within hours they were medically treated for "sunburn," as well as recurring bouts of vomiting and diarrhea apparently the results of radiation sickness Cash's skin blistered so badly she was hospitalized A week later moreover her hair began falling out in clumps

Their health problems have continued to mount Cash has undergone a mastectomy and suffered a heart attack Landrum's vision has deteriorated, and slow-healing sores have broken out on her hands and feet Young Colby's eyesight has also rapidly deteriorated and abnormal patches of hair have sprouted on his chest and back

WITNESSES There are at least six other eyewitnesses who saw the helicopters There seemed to be no reason at the time to report the choppers to the police The witnesses surfaced later however during a Mutual UFO Network investigation led by aerospace engineer John Schuessler

STATUS "We have used the term *UFO* only for want of a better word " Schuessler explains "It could have been a secret military experiment, for all we know

The helicopters were the basis for a lawsuit according to Bill Shead one of the plaintiffs' lawyers "The government had to own them and this, therefore, responsible for damages

Both the Army and the Air Force however deny any knowledge of the event Whatever they saw and whatever happened is not the issue," says Assistant U.S. Attorney Frank Confort "The question is, Why are they suing the government? It's like somebody hits your car and you decide to sue me, even though I'm not responsible for the accident"

In September 1985 a federal district court dismissed the $20 million civil suit for injuries inflicted during the alleged encounter "That's it, as far as the court system goes," Shead says The only possible relief for the victims is a congressional resolution awarding damages "It's rare, but it has happened before.

Cash, however, remains unmollified "Even if the government doesn't know what the object was then it does now," she says "Those helicopters were *there* and for the judge to throw the case out not even hearing us, is a sad decision" She adds that she'll "do whatever it takes" to bring attention to the dismissed case I'll fight until they lay me in my grave," she says I want people to know how our federal judicial system works

RECOMMENDATION The three victims saw *something* Suggest you follow up on lawyers or victims' future tactics

Anyone in the vicinity of Houston should be particularly observant if driving along Highway FM1485

FILE #1203-CT
THE CASE OF THINGS THAT GO BOOM IN THE NIGHT

DESCRIPTION Strange sounds continue to boom from both banks of the otherwise peaceful Connecticut River particularly in the area around Moodus, a village in East Haddam, Connecticut Hearsay dates events to pre-Pilgrim days when natives referred to the area as Morehemoodus, or "place of noises

Residents have reported shock waves that begin with tremors and a rumbling noise resembling gunshots or the discharge of a distant cannon The tremors are felt primarily in Moodus and other neighboring towns but sometimes at great distances as well

EVIDENCE In September and October 1987 there were more than 175 minquakes near Moodus They were the fourth swarm of earthquakes in the past decade according to seismologist John Ebel at Boston College's Weston Observatory which has monitored the quakes since 1979

"There might be something unique about the local rocks that makes them conduct sound waves very efficiently," says C. Thomas Statton, a seismologist with New Jersey's Woodward–Clyde Consultants, which has also studied the area. Statton notes that in some parts of the world the ground conducts sound so well "you can almost *feel* a thunderclap."

A swarm of anomalous quakes similar to those in Moodus occurred in Cape Fear, North Carolina, during 1978 and 1979. Residents reported booming noises, falling plaster, and rattling doors. "There are probably similar cases in many remote sites, but to notice them you need a town in the area," Ebel says.

See also case histories for 'Barisal guns,' Ganges Delta, India, reported by Sir George Darwin, and *mistpouffers* ('fog dissipators') French coast—also known as "landguns," "sky quakes" *brontidi*, and *retumbos*.

SUSPECTS. Pranksters—as well as sonic booms and exploding gas pockets—have been virtually ruled out.

The source of the sounds has been traced to an area just a few hundred yards wide, two miles north of Moodus and about a mile below the earth's surface. Quakes along California's San Andreas Fault typically occur at six- to nine-mile depths, while those in other areas occur even deeper, Statton points out. Although the Moodus noises are associated with earth tremors, there's no clear connection to the nearby Honey Hill Fault.

SUMMARY. No consensus emerged at a May 1988 American Geophysical Union symposium on the subject.

Because of the swarms' shallow, concentrated nature, "it's difficult to argue that a large earthquake is possible," Ebel says. A potentially devastating earthquake, he adds, could occur less than five miles away. "In 1791 there was a large quake in Moodus, strong enough to crack chimneys and to be felt as far away as Boston and New York City."

None of this, of course, reassures local residents, since Moodus lies between the Millstone and Connecticut Yankee nuclear power plants.

RECOMMENDATION. Follow up on studies at Weston Observatory, Woodward–Clyde, and others. Anyone going to Connecticut can contact the Middlesex County Chamber of Commerce or the Moodus town hall for information on the East Haddam village.

FILE #011506-CR
THE JUNGLE BALL ROCK CASE

DESCRIPTION. In the late Thirties, United Fruit Company land locater George P. Chittenden was exploring the tangled jungle of Costa Rica for potential banana plantation sites. In the process, he discovered a series of almost perfectly shaped granite spheres.

Clearly the highly polished stones were extremely important to whoever carved them. Chittenden's queries however drew a blank from the local Boruca Indians. No one knew how long the balls had been there, who might have made them, or more importantly, why.

EVIDENCE. Some found atop stone pedestals, the spheres range from one inch to seven feet in diameter and weigh as much as thirteen and a half tons each. In many cases the nearest quarry was 30 miles away.

One cluster, at Palaca, consists of 45 balls, while two others comprise 15 and 17. They follow no known patterns. Some lie along straight lines, and others form slight arcs. The formations, however, may be accidental, according to magazine editor and anomalist Michael Shoemaker, who has studied and written about the spheres. In one instance, the stones apparently rolled down a hill from their original location, after they had all come to a full stop, he says, the stones just happened to form a straight line.

"Chittenden and his successors located 200 of the strange stones. More were found and destroyed by banana plantation workers spurred by rumors that they contained gold. Many remain lost in the jungle."

Nothing is known about their purpose or function, either. "Some have been found at the east and west boundaries of cemeteries," says Shoemaker, who suggests that the spheres could be sun symbols or tribal totems. Among other theories, one possibility is that the spheres had a purpose similar to that of the South Pacific islanders' stone currency. But then Shoemaker adds, the Costa Rican creators would seem to have placed *tremendous* importance on money.

Yet another possibility is that the spheres were the "bowling balls of giants," muses John Keel, president of the New York Fortean Society, which studies unusual and strange artifacts. "One thing is certain," he adds seriously, "it would have taken an enormous amount of effort to carve and grind down even one of these balls to a perfect sphere. To do the job, it would have to be constantly rotated and rotating a thirteen-ton block of stone would be no easy task."

SUMMARY. Chittenden and his successors located nearly 200 of the strange stones. Unfortunately, during and after World War I, many more were found and destroyed by banana plantation workers spurred by false rumors that they contained gold. Today many granite spheres probably remain lost in the dense tropical jungle, but some have been hauled off for display. One is installed on the grounds of the National Museum of Costa Rica in San José, which also has a few others. Another is outside the Costa Rican embassy in Washington, DC.

Museum authorities believe that the spheres may be the work of the Chiriquí Indians, who at the time of the Spaniards' arrival in the sixteenth century had inhabited the area for more than 1,500 years. At least one sphere was found, seemingly undisturbed, near pottery pieces and other Chiriquí artifacts. There's no way to date the granite, however, and the sphere and the artifacts could have been placed there at different times. Shoemaker suggests. Moreover, Spanish explorers, he adds, made no references to the spheres, even though they passed through the same area near the mouth of the Diquís River on the Pacific coast, in 1522.

"Costa Rica's best-known but least understood artifact, the granite spheres, have been sadly neglected," Shoemaker says. Unless more undisturbed specimens are found and definite patterns emerge, the spheres seem destined to remain inscrutable.

RECOMMENDATION. More investigation required. Check *Earthwatch* magazine for any archaeological expedition plans that might relate to the granite spheres or other Costa Rican antiquities.

Inspect the sphere at the Costa Rican embassy. In Costa Rica, visit the National Museum in the capital. Don't call the museum from outside Costa Rica, however. For some mysterious reason, no international phone calls are accepted.

FILE #1099-IRS
THE CURSE OF DUNNELLEN HALL

DESCRIPTION. Dunnellen Hall, a.k.a. Topping House, a 28-room Jacobean mansion sits on 26 acres in Greenwich, Connecticut. Hedges and a stone wall, topped by a wire-mesh fence, shield it from roads & de gawkers.

Banker Daniel Grey Reid, who made a fortune in the steel and tin industries, commissioned the mansion as a wedding present in 1918 for his daughter Rhea and her husband Henry Topping. The cost: $1 million. At least two subsequent owners have experienced financial setbacks, some have even been indicted.

VICTIMS. In 1950 steel company president Loring Washburn was the first person to buy Dunnellen Hall—and the first to lose it in 1963, after he was beset by financial troubles.

Financier Jack R. Dick bought Dunnellen in 1968. He was indicted in 1971 at the age of forty-six, on grand larceny and forgery charges. In 1974, before the case went to trial, he suffered a fatal heart

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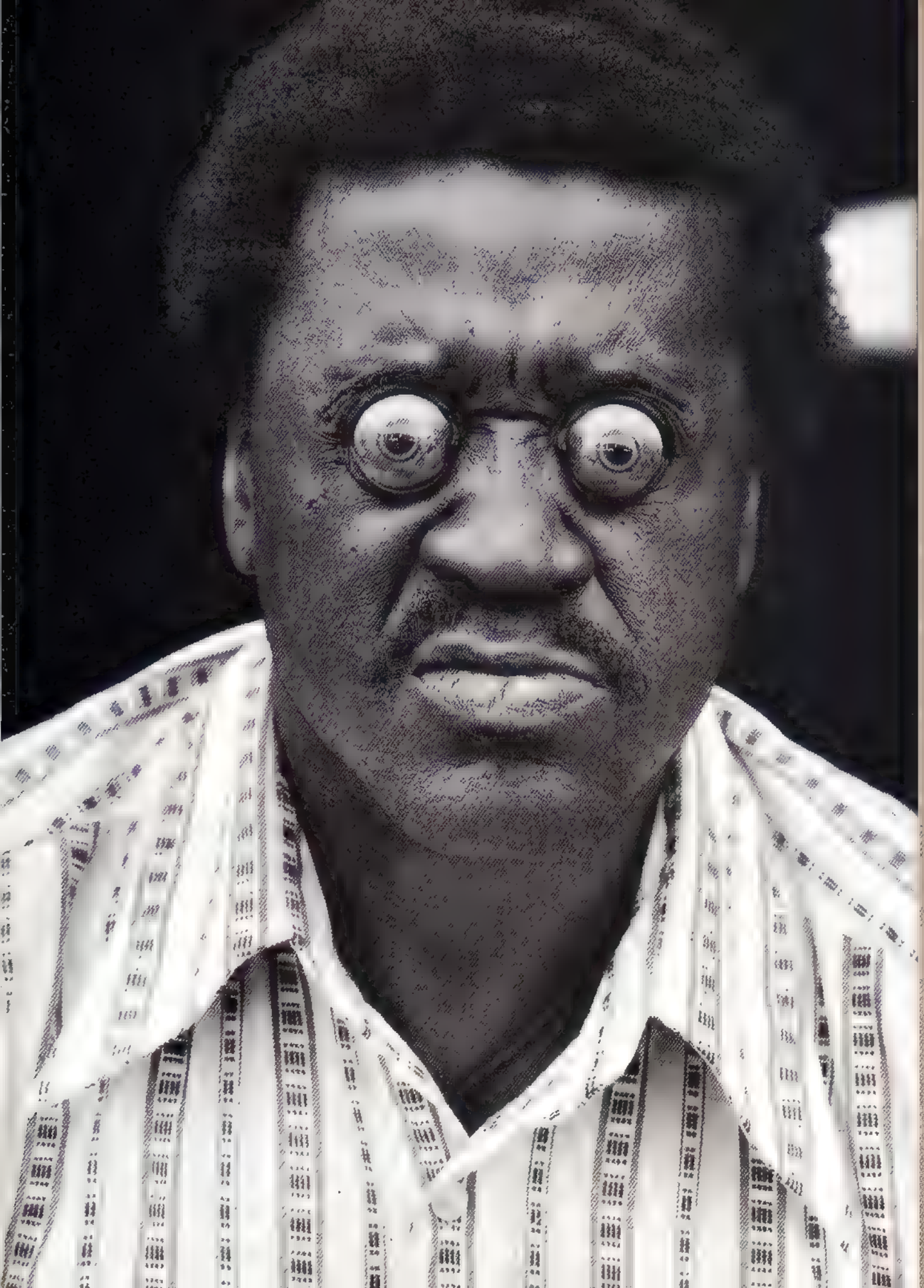


THE LAST FREAK SHOW

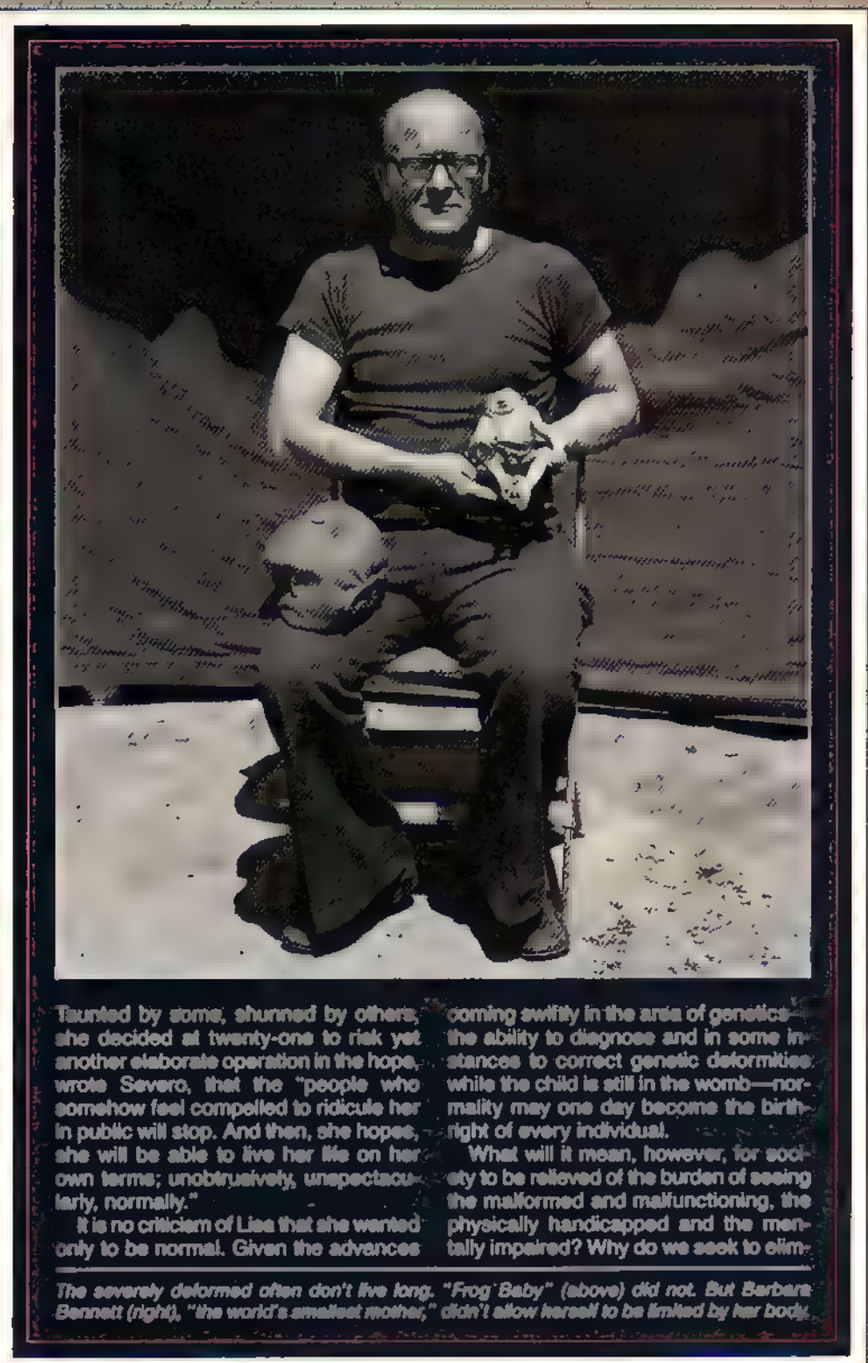
ESSAY BY CHRISTOPHER LASCH

A few years ago an enterprising reporter, Richard Severo, made a small splash with the story of Lisa H., a young woman who suffered from what is commonly referred to as "Elephant Man's disease," neurofibromatosis. Although many experts now think that John Merrick, the nineteenth-century Elephant Man, suffered from a much more severe genetic disease called Proteus syndrome, both he and Lisa shared the plight of being trapped in bodies that others found loathsome. Unlike Merrick, however, Lisa underwent radical surgery to remove facial tumors.

"Her face just won't allow people to react normally to her," said Lisa's surgeon. After 11 operations her face was still covered with tumors, her blind left eye swollen to three times its normal size, her facial bones deformed. She refused to look at herself in mirrors.

A twist of fate, a small genetic error . . . the difference between being common and winding up a sideshow freak, as Willie Ingram (left) and Stanley Barent (above) know all too well.

Known as "The Man with Two Faces," Bob Melvin is shown here with his wife, Virginia, at their trailer home in Fargo, North Dakota.



Taunted by some, shunned by others, she decided at twenty-one to risk yet another elaborate operation in the hope, wrote Severo, that the "people who somehow feel compelled to ridicule her in public will stop. And then, she hopes, she will be able to live her life on her own terms; unobtrusively, unspectacularly, normally."

It is no criticism of Lisa that she wanted only to be normal. Given the advances coming swiftly in the area of genetics—the ability to diagnose and in some instances to correct genetic deformities while the child is still in the womb—normality may one day become the birthright of every individual.

What will it mean, however, for society to be relieved of the burden of seeing the malformed and malfunctioning, the physically handicapped and the mentally impaired? Why do we seek to elim-

The severely deformed often don't live long. "Frog Baby" (above) did not. But Barbara Bennett (right), "the world's smallest mother," didn't allow herself to be limited by her body.

LIVES APART: VOICES AND DREAMS

From Vietnam War army psychiatrist, to best-selling author of inspirational books, to Christian leader, to exorcist of evil, to planner of world peace. Just what is it that makes Scott Peck tick?

INTERVIEW

M. SCOTT PECK

I'm scared for my own skin. I'm even more scared for the skin of my children. And I'm scared for your skin. I want to save my skin. I need you, and you need me, for salvation." In the book *The Different Drum* M. Scott Peck, M.D., talks about the victims of Hiroshima and Nagasaki describing them walking the streets after the blast dragging their own skins behind them. "The human race stands at the brink of self-annihilation," he says.

In the 11 years since he wrote the nonstop best seller *The Road Less Traveled,* the focus of the psychiatrist's attention has moved from self-awareness to world peace and salvation. "Life is something that happens to you when you plan something else," Peck says in *The Road Less Traveled.* The book begins with the phrase "Life is difficult" and asks its readers, all 3 million of them to accept this premise and to develop systems of

PHOTOGRAPH BY KIM STEELE

discipline that confront these difficulties

Life began for Peck 52 years ago in Manhattan His father, a self-made man, had arrived from Indiana to become a highly successful lawyer and later a judge Rugged individualism was the family philosophy Scott was sent to Exeter Academy but left to attend the Friends Seminary in New York City, where he was introduced to Zen Buddhism and the value of community After graduating from Harvard in 1958 with a degree in social relations, he bowed to his father's will and went into medicine In premed physics class he met Lily, who was born and raised in Singapore, and they were married against the wishes of both sets of parents His father objected to an interracial marriage, and her father a conservative Chinese Baptist minister objected to Pecks involvement in Buddhism

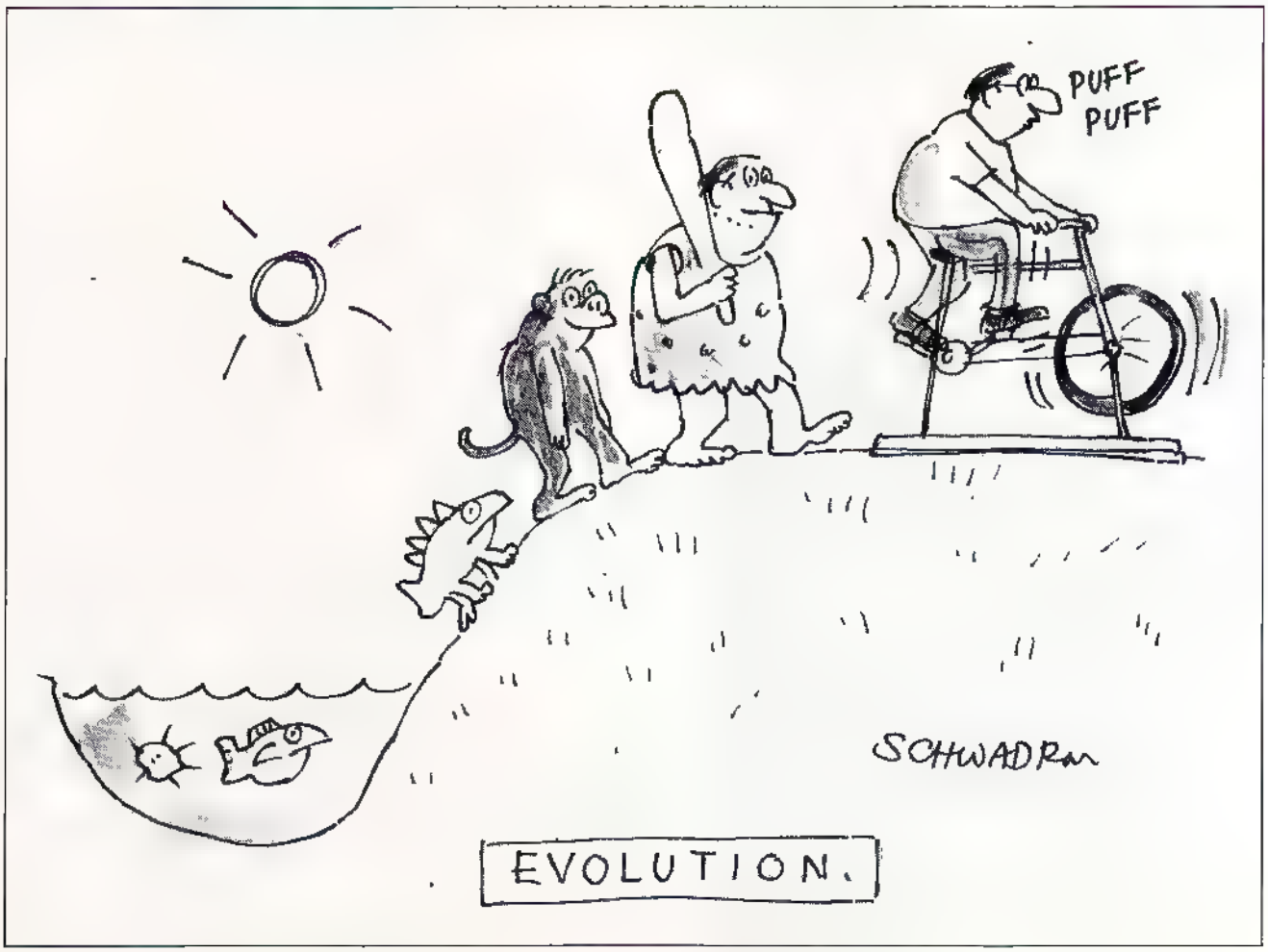
Peck spent nine and a half years as an Army psychiatrist in Washington, DC as the Vietnam War broke over the nation. But in 1972 he moved to New Preston Connecticut, to become a country psychiatrist It was in his eighteenth century farmhouse on Bliss Road that he began *The Road Less Traveled* And if you ask him why he wrote it, Peck will say, "I just don't know That gets into the mystery of vocation. It was a gift " But throughout all his writings, he openly discusses his spiritual evolution As one article about Peck put it "He is the psychiatrist who confesses his own neuroses the preacher who analyzes his own sins" Choosing to leave Buddhism for Christianity he was baptized in 1980

Even as he was embracing Christianity Peck found he had to address the subject of evil, and it became the focus of his second book, *People of the Lie* In this book, which he calls "difficult and dangerous," he describes the evil personality and vividly pictures the Devil, which he saw during two exorcisms "When the demon finally spoke clearly" Peck recalls, "an expression appeared on the patient's face that could only be described as satanic It was an incredibly contemptuous grin of utter hostile malevolence" The eyes, he continues, "were hooded with lazy reptilian torpor except when the reptile darted out in attack, at which moment the eyes would open wide with blazing attack" Peck says he could not imitate Satan's diabolical grimace in a mirror

People of the Lie describes evil characters that Peck has experienced in his psychiatric practice and whose presence he fears in politics and on TV The evil are attracted to power and can often be spotted by expression and gesture Defining Satan as a "real spirit of unreality," Peck fears "that our government to a considerable extent is pervaded and operates by a real spirit of unreality It is descending into evil

Peck wrote *The Different Drum*, published in 1987 to encourage community understanding and spiritual growth In it he delineates his "four stages of a spiritual life At the first stage there is primitive, undisciplined behavior—nothing governs these people beyond their own will Evil persons exist at stage one People at this stage are incapable of loving and are basically self-serving. The second stage is characterized by rigid, formalistic behavior, such as a blind commitment to religious fundamentalism The third is the stage of the nonbelievers. These people, often involved in social causes or science, are skeptics and truth seekers Although they may find what they seek, to Peck, it is "never enough to complete the whole puzzle because they're always questioning and missing the bigger picture For Peck, that's the "mystical unity beyond truth "

It is stage four, of course where barriers to true communication break down expectations dissolve, and people learn to rejoice in the resolution of individual differences At stage four people embrace paradox and are able to submit to something higher For Peck that something higher is Christianity His religious beliefs permeate his writings, and it's difficult to distinguish his personal spiritual



ideas from his sociological or even medical ones. Although he has been thoroughly criticized for this, he steadfastly maintains that "we must ultimately belong to either God or the Devil."

The Peck home on Bliss Road, just a stone's throw from Lake Waramaug, was under renovation when therapist and writer Diane Connors interviewed Peck. Two older daughters were home from graduate school, as was a son born when the Pecks were stationed in Okinawa. Connors met with Peck in the son's pottery studio, surrounded by works in progress. Nearby bookshelves held copies of *The Road Less Traveled* in translation (in Portuguese the title reads *Formacio de Personalidad*, or "Formation of the Personality"; in Italian, *Vogo de Bene*, or "The Good Path.")

Peck looked relaxed. Casually dressed in a plaid shirt, he described his day of prayer, meditation, and work. Yet his hands trembled as he leaned back in his chair and smoked his cigarette. He doesn't play golf or have much of a social life anymore but looks forward to a month on a remote island where there will be no typewriter. Ahead of him was a full schedule of lecturing, community-building workshops, and soliciting funds for his Foundation for Community Encouragement, Inc., the Knoxville Tennessee-based organization designed to build community spirit through workshops.

Peck snapped when Connors suggested that he was a workaholic. Actually he likes to do nothing, he said, but sees himself as a "responsibility-aholic."

Peck's novel *House of Charron*, about a murder in a nursing home, is due to be published this month by Bantam, with which he recently signed a two-book, seven-figure contract.

Omni: *The Road Less Traveled* has been at the top of the best seller list for years. Did you always want to write?

Peck: As a kid I wanted to be a writer. One of the blessings of my life was meeting Carolyn Bryant, the mother of a classmate. She was then the head of Bryant and Bryant, a leading publishing agency of the day. She and I kind of fell in love. I was thirteen, and she was forty-five. About six feet tall, she wore her hair piled up high and had long, Edith Sitwell fingers with great topazes on them. She became my Auntie Mame, plying me with caviar, cigarettes, and champagne. And I'm sure if I had asked for them, women.

Omni: What did you dream of writing?

Peck: I'd always been a reader, but somehow reading *The Grapes of Wrath* escalated things. Then, in English class at Exeter, my teacher read my composition to the class and compared it to Steinbeck. I was badly in need of self-esteem. I decided to be a great American writer. That lasted until I was about twenty-one, when I decided to do something responsible and go to medical school. Looking back on my life, I see I was designed to write the books I did. I was one of those introspective kids, and my parents said to me—oh, hundreds of times—"Scotty, you think too much. It's actually a terrible thing to say to a child. What are human beings supposed to do?"

Omni: When did you decide to go to medical school?

Peck: In my senior year at Harvard. I hadn't taken any premed courses, but I'd gotten interested in psychology, and medicine seemed a good way to make a living. The year between college and med school I took most of my premed courses at night, working at Bellevue Psychiatric Hospital in New York during the day. Because of that year at Bellevue, I thought psychiatry was terribly depressing. Psychiatrists, I thought, never really fixed people. I was going to fix people. So I went through medical school laboring under the illusion that I would be a GP [general practitioner]. When we talked about some fracture, I would imagine myself in some little Mississippi town at two A.M. setting that particular kind of fracture in my fantasy. I was going to be a missionary. But then, just weeks before med school ended, I realized I didn't want to be a GP or an internist. What I liked to do most was to talk to people.

Omni: Where did you meet Lily?

Peck: During my year of premed at Columbia University. The first course I took was given by the best teacher I ever had. He began the first class by saying, "My name is Professor Payton. It rhymes with Satan, and I have certain beliefs by which I teach. One is that all students cheat. Consequently, after today you'll sit three seats apart from anybody to remove you from temptation. It will also help to circulate the air and gases among you." Then he moved into the subject of gases and took off.

Lily was assigned three seats in front of me. Every morning at eight I used to look down the back of her neck. I was dating someone else at the time, but we continued to see each other in the fall of 1958 and were married in December 1959. We were married on the twenty-seventh, went to immigration on the twenty-eighth, and on the twenty-ninth Lily went out shopping for knives and forks. She dropped out of school to support me. Lily is Chinese. Her father is the only person I've ever heard of who came to this country as a missionary; they needed a conservative Baptist minister in Chinatown.

Those were our best years. My parents objected to my marriage, and I was temporarily disinherited, so we had no furniture, no car, and no groceries. Later I was reinherited; my father paid for my tuition and gave us one hundred dollars a month. Lily worked until our first child was born a year and two thirds later.

"Chicken soup"

Omni: How did you first become involved with Buddhism?

Peck: I was raised in a very secular home, but as I look back on it, I was a freakishly religious kid. I had a thirst for religion. Christianity meant nothing to me, though, I thought it was so much gobbledygook. At Friends there was a course in world religions, and I ran across Hinduism, Buddhism, and mystical writings. I just fell in love. It made sense. At eighteen I'd have said I was a Zen Buddhist; that was before it was fashionable. But I don't remember wanting to turn anyone else on to it. Mysticism is practically impossible to talk about. This is why Zen has always been associated with martial arts, flower arranging, and painting that has to be done quickly. Christian theory is much easier to talk about.

Omni: How did you make the transition to Christianity?

Peck: Gradually I began to sense that Christianity offered more than other religions in dealing with issues of sin and guilt, remorse and contrition. Guilt can be very good. Somebody who murdered babies in Vietnam, for example, has bad dreams. I would say, "I will try to help you, but first let us celebrate the fact that you had bad dreams."

In my psychiatric work my primary interest in long-term therapy involved substantial personality change. I began to see that something would invariably happen: this therapeutic depression, as I called it, occurs one to two years into therapy. The patient becomes more depressed than ever. The old way is clearly pathological, maladaptive, and sick, so they can't go back. But the new way is so difficult and risky that they can't go forward. They say, "What's it all about? Why grow or work? I'm just going to kill myself." These spiritual questions find no answers in the psychiatric textbooks. Partly out of that struggle I became less happy with mystical thought, which generally isn't helpful on a day-to-day basis. I found myself yearning for something less abstract, more carnal.

Omni: And in the late Seventies you encountered the Gospels?

Peck: Yes. It happened after I had written the first draft of *The Road Less Traveled*. I'm no scholar. I do the writing first and the research afterward. Having quoted Jesus a couple of times, I decided to check out the references in the Gospels. Had you asked me a dozen years before whether Jesus was real, I'd have said, "Historically, Jesus was a wise chap who got executed for some standard of the day. This is no worse than executing people not so wise. But somehow they built a religion around him."

But when I finally read the Gospels with a dozen years of experience as a psychiatrist under my belt, I found out what it's like to be a teacher. I was thunderstruck by the reality of this man who was almost continually frustrated. "What do I have to do to get it through to you?" he'd say. "How many times do I have to say it?" He was a man who was often angry, scared, sad, or even prejudiced on occasion. And terribly, terribly young.

It suddenly occurred to me that if the Gospel writers had engaged in myth-making, they'd have created the Jesus who three fourths of the Christian world are trying to create: what Billy calls "the wimpy Jesus," someone who goes around with a sweet smile on his face and does little more than pat children on the head with this kind of unshakable equanimity, this "mellow-yellow peace and love" consciousness. The Jesus I found was a person nobody would be able to make up.

Omni: That became a concrete form?

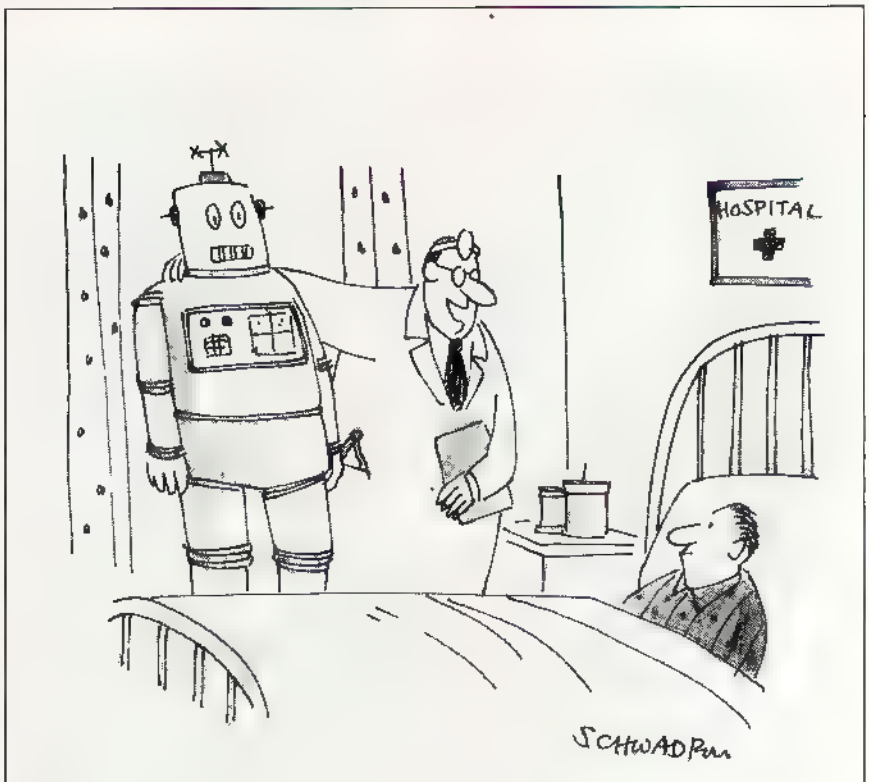
Peck: I was boondoggled with reality and a tangible example in Christian doctrine. Jesus is referred to as "the Word." If you want to know the right way to go, come down and hear how Jesus would have behaved in a situation. For example, one of my habitual sins is wanting to be liked. I'm a compulsive Mr. Nice Guy. About seven years ago, before I became famous, I was still answering my phone. One night the phone rang. I answered it, and an elderly woman asked, "Are you the Dr. Peck who's going to be talking about sexuality and spirituality at St. Michael's Church Friday night?" "Yes, I am." "Good. I'm taking my husband because he says he's too old to have sex. I want you to tell him he should have sex with me." "That's not necessarily the subject of the talk," I said, "but if at the question-and-answer period you come up, I'd be happy to talk about it. I'm glad you're going and hope you enjoy it." Well, I hung up and thought, *How would Jesus have handled that phone call? It was very clear. He would have said, 'Lady, where the hell do you come off? That was the most narcissistic thing I've ever heard of. Trying to tell me what to talk about! Maybe if you become a little less self-centered, your husband might like you more.'*

Omni: You didn't say that?

Peck: No, but I should have. And that speech was a total bomb. As soon as people started coming into the church, I knew something was wrong. I'm fascinated by group spirits. I'd given this talk before, and there were about twelve places where you could laugh. During this whole talk there was not one nervous titter. This spirit was so oppressive. I thought it had partly to do with that nasty, narcissistic woman being there. If I'd told her off, maybe she wouldn't have come, and the spirit would've been better. Single individuals can do extraordinary amounts to break down a group. How, I don't know.

Omni: *The Road* was written a decade ago. How do you feel about it today?

Peck: It bores me to tears. I'm not one to write the same book over and over again. Because it's been out the longest and



"We're giving you an artificial heart, and we thought you'd like to meet the donor."

NOTHING ATTRACTS LIKE THE IMPORTED TASTE OF BOMBAY GIN.

CORIANDER SEEDS FROM MOROCCO ANGELICA ROOT FROM SAXONY JUNIPER BERRIES FROM ITALY CASSIA BARK FROM INDOCHINA ALMONDS FROM INDOCHINA LEMON PEEL FROM SPAIN ORRIS (IRIS ROOT) FROM ITALY LICORICE FROM INDOCHINA

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been so successful, people are still terribly interested in it.

Omni: What inspired you to write it?

Peck: When I came here to Connecticut in 1972, after I'd gotten out of the Army, it was with no greater ambition than to be a country psychiatrist and play golf on Wednesday afternoons and weekends. The first year I worked pretty hard at getting my practice started. Then I joined the country club and played golf. Three years later, I was sitting in my living room, and this book said, "Write me!" I said, "Scotty, you've had funny ideas before." But it still said, "Write me." So I spent the next six weeks revising my schedule so I could write and stop playing golf. I wrote the first draft in less than twenty months. But the basic ideas had grown up over years.

Omni: The book's almost as popular as the Bible. Why haven't professional journals given it consideration?

Peck: First of all, I'm a thinker, not a scholar. In the professional journals there's a very different kind of writing than mine. Second, there's been a strong nonreligious tradition in psychology and psychiatry. I've violated that tradition, and I think that tradition is going down the tubes. Third, there's a tendency among academics to think that if something is popular, it can't be academic. Many things differentiate my work from pop psychology, but a lot of Ph.D. types would be embarrassed that *The Road Less Traveled* has gotten such a reputation.

Omni: Some find your handling of issues in relationships—love, commitment, and so on—to be very helpful.

Peck: That's generally what the more secular community, or stage-three people, find most helpful. And they wish I hadn't included the last part about grace. The book was first submitted to Random House, and the editor called me and said she was going around telling everyone about this marvelous new manuscript. But when she got to the third part, she said, "You blew it. It's too Christ-y." It's the religious community, however, that responds to that section. Writing is a bit like psychotherapy. You often can't understand what your therapy was all about until you are three or four years out of it.

Omni: What were you trying to accomplish in *People of the Lie*?

Peck: The stage-two people, the fundamentalists, know or believe in the reality of evil. But they use the concept in very simple and destructive ways, such as, "Anyone who doesn't believe the way I do is possessed by the Devil." Stage-three people are sophisticated and know that what is considered good in one culture can be bad in another. They think all this "evil stuff is relative. But they're wrong. I hoped to take the concept of evil and say that it is absolutely real.

After *People of the Lie* was published, I received about three times as much mail as I did for *The Road Less Traveled*. A lot of the *Lie* mail comes from people who've had some actual, usually devastating experience with evil. The letters that really hurt me say, "Thank you, Dr. Peck. Now that I've read *People of the Lie* I know that my mother is evil, my husband is evil, and my boss is evil." Even so, the most common one is, "Thank you, Dr. Peck. Now that I know my mother is evil I can forgive her." Most of the people were caught up in confusion, guilt, and anger and not able to objectify it until then.

Omni: How do you feel about your third book, *The Different Drum*, and the mixed reaction it received from the press, especially *The New York Times*?

Peck: It was much the same as the review of *People of the Lie*. New York is the center of the publishing industry. Not that this is anti-Semitic, but it's stage-three Jewish. I'd guess that a stage-three Jewish person reviewed both books. It's not likely they would be able to give a favorable review to something written by a stage-four Christian. I'm not knocking stage-three Jewish people, stage-three people are ahead of stage-two people, fundamentalists. The editor I spoke of, who turned down *The Road Less Traveled*, was a nice Jewish lady who has been kicking herself in the ass for some years now because of her mistake.

Omni: *The Different Drum* discusses the fourth stage and moves from the individual to the community. Why?

Peck: An amazing number of people into their personal growth have virtually no interest in group health. This reflects the individualism of our society; people often have a sense of their own sin but no sense of corporate guilt, corporate sin.

Omni: What's the difference between personal and corporate sin?

Peck: When Reagan talks, I feel ashamed for my country. I feel sickened, bothered, or guilty. But a lot of people don't seem to have that. They may feel bad about something they've done but have no sense of group. Last summer I was out in Chicago, doing this workshop with about five hundred people. So I divided the day in half. In the morning I addressed the issues of sin, guilt, remorse, and contrition at an individual level, and in the afternoon at a corporate, group level.

The morning bombed. At first I thought they were just lazy. Then after lunch a lady raised her hand and said, "Dr. Peck, I just want to voice a serious concern about the way you have been blessing the sexual behavior of Jimmy Bakker and Gary Hart." About a third of the audience clapped. Well, I said, "That was not my intent." What I'd said was that I'm puzzled as to why people get so bent out of shape about the sexual peccadilloes of these people for whom they have no responsibility, yet tear apart. At the same time they have no concern for such things as pornography, the unbalanced budget, or the insanity of the arms race. People have a terrible tendency to want human gods and then get furious at them. It's self-destructive of group function, and it's one of the deterrents of our political system.

Omni: You have moved toward social and political consciousness. Why?

Peck: I first became interested in disarmament when Senator Joseph McCarthy was potent. When I was fourteen I was homesick, so I hooked into a radio speech by McCarthy. I knew nothing about him or Communism. But that man's voice was so ugly that after about forty-five seconds I had to get up and turn it off. I can remember saying to myself, 'That's the voice of evil.' That was a powerful experience not only because it was evil but because I became aware for the first time that our country was not perfect. I began to question the whole anticommunist thing and world politics. That's what led to my protesting against ROTC in 1956.

Omni: How do you account for someone like McCarthy gaining so much power? Could it happen again?

Peck: Oh, yeah, it could. But the subject of evil is so filled with mystery. I don't yet know what creates a McCarthy. Those I call "the people of the lie" are powerful, strong-willed people for whom the ends justify the means. They want power, and politics is an arena toward which they tend to gravitate. There's no question about McCarthy being one of them, but about LBJ, for instance, I'm not completely sure.

Our politics are so compromised today that people who get in and survive are those willing to compromise—in a bad sense. Something about our political process either kills integrity or drives out people with integrity. I won't make a carte blanche statement, because there are a tremendous number of exceptions, especially in state government.

Omni: Have you campaigned for anyone you felt needed support?

Peck: I haven't, but I would if I got to know someone well enough to feel they were the right person to be in office. With the possible exception of Jesse Jackson, I don't know any president a candidate I'd campaign for, because the political system is screwed up. Our system of government is based on our rugged individualist kind of thing and is an adversarial system. Most people have no familiarity with any other way of working. One reason the presidency has become so powerful is because of the inefficiency of Congress, and that's because Congress works on an adversarial system.

Omni: After you graduated from medical

school you opted for the Army. Why?

Peck. I was married with two children and interns weren't paid anything. The only place you could get decent training at a livable wage was in the federal service. If you asked me then where Vietnam was, I would have said it's someplace in the other hemisphere, and all the world looked peaceful. I looked through a glass darkly then. It was almost two years after I went into the Army before I got upset about what was going on in Vietnam. I became an objector but with a five-year obligation ahead of me and young children, going to jail didn't seem like a nice thing to do. I researched what happened to people who went to jail back then in '65 and '66, and they were just lost. Maybe it was a cop-out, but I decided to be one who worked from within. Actually I became interested in the relationship between psychiatry and government. So I stayed nine and a half years.

Even though my job was sort of dinky on the surface, I knew the Army was in a lot of trouble with drugs, race relations and antiwar dissent. These problems required the understanding of a social scientist and a psychiatrist. Dysfunctions of the individual and dysfunctions in political life are enormously analogous.

Freud, in pondering what caused neurosis, came up with something he called repetition compulsion, a fancy way of saying that people tend to do the same stupid things over and over. Sometimes people ask me, "We've all got neuroses, how do I know when to get into therapy?" I say, "When you are stuck like a needle on a broken record."

Well, the arms race is obviously an example. We keep doing the same stupid stuff over and over, so obviously there is something dysfunctional. Groups are organisms created by individuals, so they obey many of the same laws as individuals. And again, people have this terrible tendency to want others to be heroes, and then they get furious at them. It's destructive in group functioning. I tell them I'm not interested in being a goddamn hero.

***Omni*:** How do your community workshops work?

Peck. The most popular topics are those on individual spiritual growth. Corporate stuff is less popular because most people aren't ready for mature social action. This may sound snobbish, but people first need to go into therapy before they're ready for mature social action. A lot of congressmen and senators spend eighteen hours a day working on social action but for the wrong reasons. They don't know anything about themselves.

Building community through workshops is the cutting edge of my life. And what I've become, willy-nilly, is an evangelist of sorts and quite a successful one. Successful evangelists generally build big machines around themselves and then when they die or commit an indiscretion, the whole thing collapses. I don't want a big machine dependent entirely on me. I want to be able to go off and commit an indiscretion! For this and other reasons, I put the Foundation [for Community Encouragement] as far from me as we could.

***Omni*.** Is involved just with community workshops?

Peck. When we started the foundation we found ourselves overwhelmed by mail from people asking for help. The prototypical letter would be from a dentist writing from Austin, Texas: "Dear Dr. Peck, I've been depressed since my divorce three years ago. Could you recommend to me a spiritually oriented therapist in the Austin area?" And the nearest one we'd know would be in Dallas. The problem of the correspondence, we soon realized, was also a community problem. There's something ridiculous about somebody from Austin writing to somebody in Connecticut to refer them to somebody back in Austin. So we employ someone full time to coordinate this mail.

"The letters that really hurt me say, "Thank you, Dr. Peck. Now that I've finished reading People of the Lie, *I realize that my mother is evil, my husband is evil, and my boss is evil."*

***Omni*.** Is the foundation Christian?

Peck. Because community is not exclusive, we deliberately designed the foundation to not be specifically Christian. We're into promoting community wherever. Our board often has one Jew, probably two agnostics, and we're eagerly looking for a wealthy Hindu. Our board is a working board.

***Omni*.** What kind of people generally attend the workshops?

Peck. Most people who come to my lectures have been in therapy, as have most who come to community-building workshops. But actually it's easier to build community among unsophisticated than sophisticated people, who are better able to fake it. In the thirty workshops that the foundation has done without me, only one did not make it to community—the fourth stage, where people accept individual differences and paradoxes. They were a group of psychiatrists.

In my book I wrote about the importance of the dreams we use in groups. Each of my groups has a group dreamer. This workshop of psychiatrists was held outside a city, across a river, and there was a bridge. Sunday morning the group dreamer dreamed that there was a convoy of forty-two brown Volkswagen convertibles going down the highway toward the city. When they came to the bridge, they found a tunnel in its place. That tunnel was marked EMPTINESS. One by one the forty-two brown Volkswagen convertibles turned around and went back to the country. Interestingly, though we thought that workshop was a failure, these therapists accepted responsibility for it. They didn't blame the leader. It was their own kind of defensiveness and therapeutic detachment that led to this failure to make it to community. And people from that group came to other groups.

***Omni*:** Do you study the effects of the workshops on community interactions?

Peck. I can give you anecdotal evidence that doesn't account for beans. I'm delighted we're raising money and that in the process of hiring a director of research to do scientific follow-ups on one particular group and everything else, we can research about community building. We're beginning a program with leaders of communities to learn more about problems of community maintenance, as opposed to development. In a few years we'll have enough data to do a major scientific study of the community.

Research is very important. Science is a series of conventions and procedures developed over the centuries to combat the human tendency to deceive ourselves. It was developed in the interest of something higher than our immediate emotional and intellectual comfort, namely the truth. So science is principled behavior to get to the truth. And the truth is one of the synonyms of God. So I see science as a very holy activity. But a problem with science is that there are certain things that either cannot be measured or can be only partially measured. There are other ways of knowing than through the scientific method. Science tends to idolize itself and say, 'Well, what can't be known through the scientific method isn't knowable or isn't worth looking into.' That's tunnel vision.

***Omni*:** The family forms the primary group. What advice would you give to parents?

Peck: If I could give one thing to parents, it would be the capacity to remember what it was like to be a child. It is not stress but being out of touch with stress that kills. Anyone who believes they had a wonderfully happy childhood is just out of touch. In the early days before black consciousness developed, I saw some black soldiers who were suffering from anxiety attacks. I'd say, "Have you ever experienced prejudice?" They'd say no, and I'd say, 'Bullshit.' Among other things, you've been a child and experienced the prejudice against children.' And of course they were out of touch with the prejudice they experienced as adults.

***Omni*:** Do you envision some kind of secular education?

CONTINUED ON PAGE 138

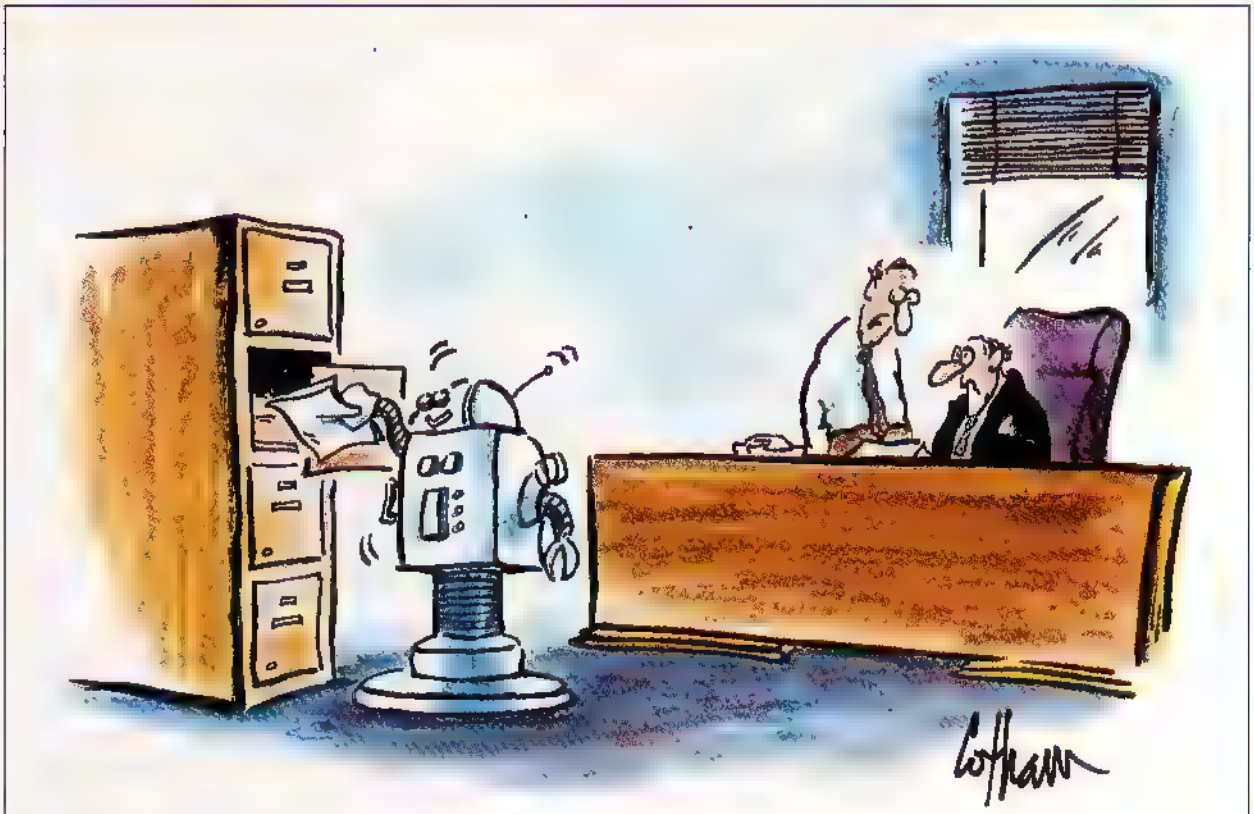
GREAT MOMENTS IN SCIENCE

CARTOONS BY FRANK COTHAM

"Kindly show this gentleman the fly in your soup."

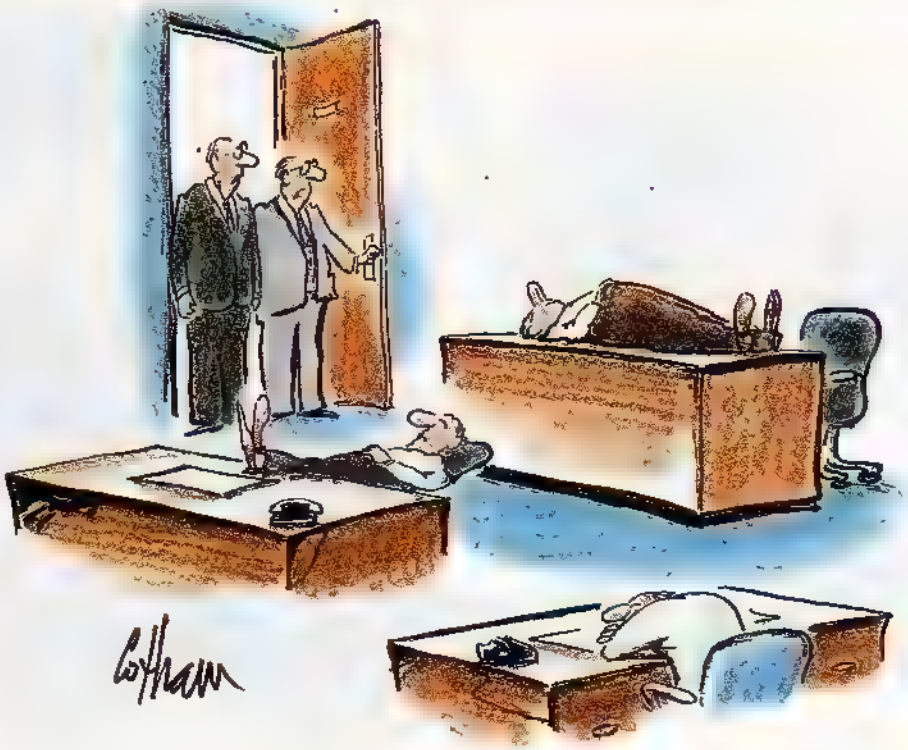
"Tell me, how many millions in research money have you spent on this problem?"

"Do you remember, sir, when I told you I had developed a one hundred percent effective truth serum? Well... I lied."



"There's no need to tell him he's fired. Just remove his batteries."

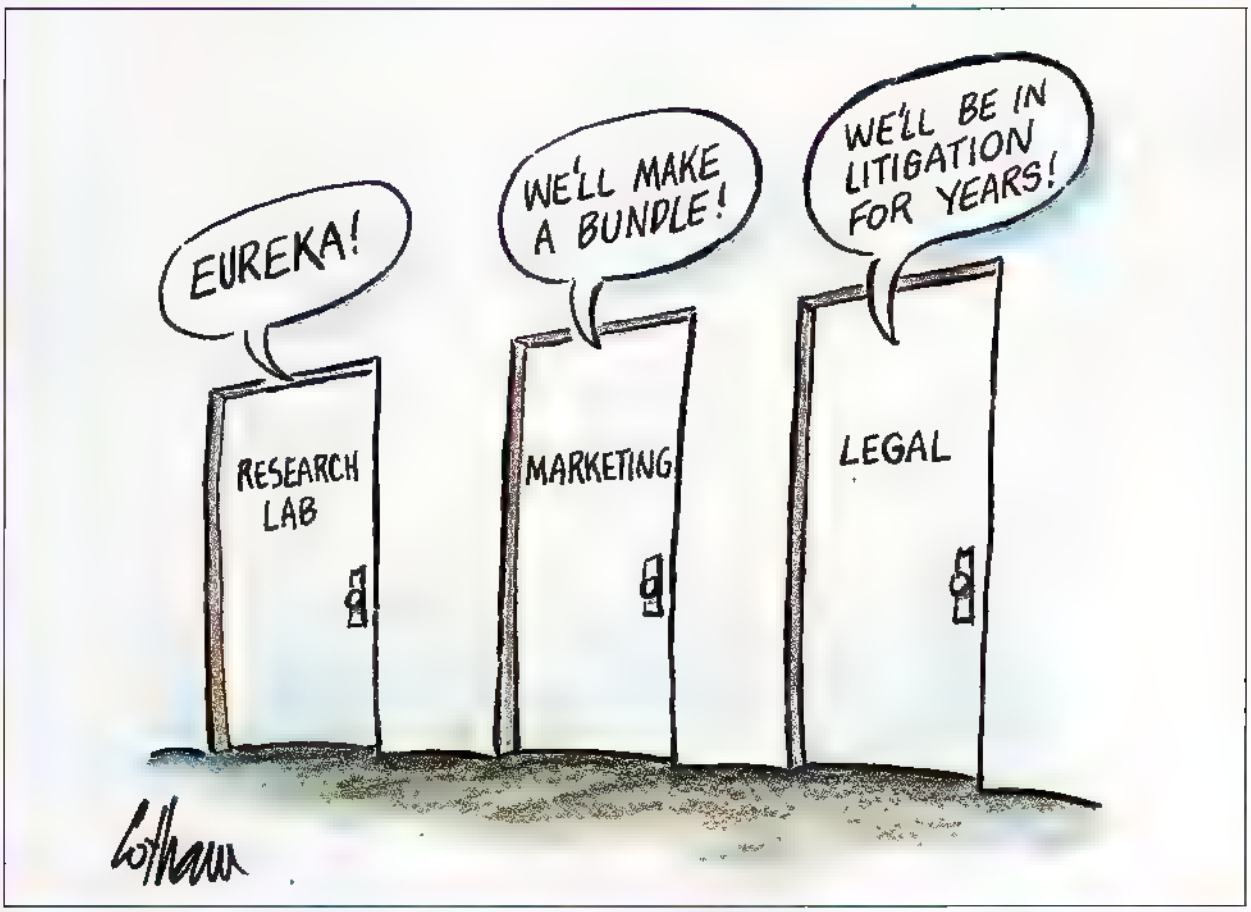
"Good! I see our crash research program is showing results!"



"The power must be off."

"I shall expect a chemical cure for psychopathic behavior by ten o'clock tomorrow morning or I'll have your guts for spaghetti!"

"Take as long as necessary to familiarize yourself with the equipment."



INTERVIEW

CONTINUED FROM PAGE 132

Peck: There is no way to teach values without teaching God or a higher power. Once you get into a higher power by definition it's no longer secular. When I had the opportunity to talk on the subject with educators I reminded them that the young Einstein had hoped to develop the unified field theory which was going to explain everything. Toward the end of his life he said, "Subtle is the Lord." And so it behooves us to teach God subtly. I oppose heavy-handed fundamentalism and attempts to censor. But it's not either that or no higher power in education.

Omni: What are your feelings about television's influence on children?

Peck: Like so many things, I have mixed emotions. Incidentally, do you want to know the definition of *mixed emotions*? That's when your daughter comes home at four A.M. with the Gideon Bible under her arm. Anyway, TV does a lot of good stuff, but there's a lot of stuff that lowers the consciousness, too. Looking at MTV that was an eye-opener! I'd heard stuff about rock being satanic, and you can tell it's so by the colors, sounds, and facial expressions you see on the screen.

Omni: What do we do about it?

Peck: What do I do about it, or what do we do about it? One of the things that I really get pissed at is everybody expects the great Dr. Peck to do it all. I don't have the energy to do everything. Again and again people say, "Dr. Peck, your principles are so wonderful, why don't you write a children's book?" And I say, "Wonderful idea. Why don't you do it?"

There is a lot of stuff that Scott Peck doesn't know, when, for example, I suggested in *People of the Lie* that evil in a certain way is incomprehensible. Why would somebody come into a community-building workshop with an agenda to destroy it? But they seem to. One reason for the Satanism that's running around today has been a tremendous hypocrisy and the failure of the Christian Church. The only real evidence I have for the rise of Satanism are cases of possession because we have a pretty good profile of a person who has become possessed. In other parts of the profile of the possessed person's character we find somebody who's been screwed by the Christian Church, and they have good reason to hate the Church. If, for example, they had been sexually molested or raped by somebody.

Omni: What are other personal encounters with evil?

Peck: Character defects. The myth about making a pact with the Devil has an element of truth in it. Reality suggests that the primary motive is loneliness, but to make that pact there has to be a character defect. Yet people who are possessed are not evil; they are potentially holy people. This is something that has been confirmed out of my own experience in the last few years. We get many requests for help from people who are possessed. The mental health community doesn't believe that they exist. The Church believes them, but sends them back to the mental health community to get help. These people have no place to get judicious help. We've had several conferences to deal with this problem.

You're going to find that possession is a growing diagnosis, along with multiple personality disorder. Although that's the diagnosis closest to possession, the treatment is opposite. People with multiple personality disorder need integration of the different personalities; people who are possessed need the possession kicked out of them.

When I was in college and working in the state hospital we had catatonics up the kazoo. Now we never see catatonics, but anorexia and multiple personality disorder seem to be escalating. You could say well it was there all along, but we're just beginning to recognize it. But I think there are also some shifts that we don't understand. And just as multiple personality disorder seems to be a growing diagnosis, twenty years from now possession will be viewed as a valid diagnosis. The diagnosis has to be made carefully.

Omni: Are you called upon to participate in many exorcisms?

Peck: Not really, because I say no. Now, there is a difference between a deliverance and an exorcism. I might be called in on a deliverance as a consultant.

Omni: What's the difference?

Peck: The kind of difference between lancing a boil or abscess and brain surgery. Dealing with an abscess takes twenty minutes. A deliverance is a kind of miniexorcism. It takes four to six hours. An exorcism takes four days. I'm not sure deliverance works. There's a lot of ambiguity and different degrees of possession. Sometimes it's called "serious oppression" and others "demonic attack." Possession needs research.

Christian theology poses that we are all perhaps under demonic attack. Satan is lurking around looking for some kind of inroad. In demonic attack the inroad hasn't been made yet. In oppression the attack has been somewhat successful but really hasn't penetrated; in possession the attack is complete.

Omni: When you speak, do you see yourself as a psychiatrist?

Peck: I don't believe in dividing myself into categories. A scientist, religious person, psychiatrist. I'm all of those things. I never see myself as just one of them. With my work I don't have time to play golf anymore or for a social life. My extroversion score was two, my introversion score seventeen. My wife and I are very content. Though I'm out in the country I have a great deal to do with other people. And I have many friends. OO

SPACE

CONTINUED FROM PAGE 30

speeds of about 1 percent that of light. "That's still almost a thousand times faster than existing rockets," he says.

In fact, Chapline thinks that this combination of relatively low cost and relatively high velocity would make a fission fragment rocket interesting for missions within our own solar system; it might even be considered for NASA's proposed manned mission to Mars. None of the current propulsion systems, he says, can get a man to Mars in less than two years." Other experts have estimated that in that time the radiation load on the astronauts would prove so great that they would have as much as a 20 percent risk of getting cancer. The far greater velocity of the fission fragment rocket could, Chapline thinks, reduce the time necessary to get to Mars from a dangerous two years to a far safer six months.

At the same time, engineers building a fission fragment rocket for a Mars mission might come to understand the technology well enough to try to build a truly interstellar craft. "There are no fundamental physical barriers," Chapline says, "it's just practical engineering problems and cost—perhaps as much as one hundred billion dollars for the fuel. For example, although it is now possible to produce small quantities of americium 242, there is still no facility for producing the fuel in large enough quantities to reach Alpha Centauri.

To some, however, such problems seem overwhelming. "I looked into fission fragment rockets twenty years ago," says Robert Forward, who now has an Air Force contract to investigate interstellar propulsion schemes, "and I couldn't come up with a good way to actually get the fragments out of the rocket. Chapline's a bright guy," he concludes, "but I wish he'd give us a little more to go on."

Still, Chapline has support. "We're interested," says John Callas, a member of the technical staff at the Jet Propulsion Lab (JPL) in Pasadena, California. This is a simple device that potentially could generate a high specific impulse. It doesn't require the major technological breakthroughs matter-antimatter annihilation propulsion requires, or the large-scale space structures and optics a beamed energy propulsion system needs to achieve an interstellar flyby."

The powers that be at NASA, of course, listen very carefully to opinions and recommendations from the JPL, and the agency is currently sponsoring part of Chapline's research through the Idaho National Engineering Laboratory.

The big question, then, had been whether NASA should consider Chapline's idea for an interstellar flyby. Callas's response was unhesitating. Our conclusion, he says, "was yes." OO

FICTION

John and Emily's communication problem might herald the end of life as we know it

IN A WORLD LIKE THIS

BY NANCY KRESS

My wife makes out her shopping lists not in single words but in dependent clauses and prepositional phrases. She will write "fruit but not apples, which we have," or "kuchen, for Sunday AM." This habit sparks in me a deep, primal dislike—for its manneredness, its pretentious completeness. Emily knows this. "You realize you're being ridiculous," she says. I know it. I answer, having already been put at a disadvantage

PAINTING BY RUDOLF HAUSNER

by the pettiness of my objections, and now at a further one by admitting them. "I can't help it."

"Of course you can."

"I'll tell you what," I say, trying to salvage dignity through jocularity—always a risky move. "So long as you don't end the clauses with a period."

Emily smiles at me the slant-eyed smile that she often wears in bed. "Fair enough. No periods."

The next time I come across her shopping list, it says "tampons, formy."

She has left it on the kitchen table, where I am sure to see it.

"Look at this, John," Kip Lowry says after we settle ourselves on the 7:42. He has opened his newspaper and it is flapping over into my half of the seat. Kip works for some scientific/political think tank downtown and reads the morning newspaper with an intensity that would make me wonder exactly what he expects to see there, except that I suspect it of being a pose to look more knowledgeable than he is.

"Two earthquakes last night. Mexico City and Moscow. And both registered exactly the same on the Richter scale."

"I didn't think the Reds released that information," I poke at the edge of the newspaper, nudging it back toward Kip. He frowns and glances at me evasively. Watching Soviet information may or may not be something his institute does.

"Who knows? Look at this—another burglary in Hickory Village."

Hickory Village is the subdivision in which we both live. I crane my neck toward the paper I have just pushed away.

"The cops don't have any leads," Kip reports. "When do they ever? Hey, look at this—some guy in Albany just won the New York State Lottery for the second time! Do you know what the odds are against that?"

"High," I say apparently too sourly. Kip gives me that evasive glance once more. He does this at parties as well—starts a subject that touches on his specialty, something called information theory, and then suddenly shies away as if his listeners were moving toward something politically sensitive. I dislike the habit intensely. He also wears wide-brimmed, overly dramatic hats.

"A Russian last name for that lottery winner," Kip says slowly. I close my eyes and pretend to sleep. Whatever Kip thinks he is looking for, or wants me to think he is looking for, he can look alone.

The lobby of Jefferson Tower rings with jackhammers. I step over chunks of floor and rolls of sodden carpet to scream at the receptionist. "What happened?"

She screams back, "Water leaking from someplace. They can't find where. Damnedest thing—ruined the carpet!"

I can't consider the carpet, which has always looked like cold oatmeal with pebbles in it, to be much loss. The noise on the other hand is unbearable. Even in my office on the eighth floor the jackhammers are audible, like a steady whine from huge but distant insects.

Helen, my secretary, comes in with a sheaf of papers. She looks distracted.

"This is the agenda for Ken Robinson's meeting at ten because he wants to be sure everyone sticks to both the topic and the time frame. This is the script for the new training film because the production studio is booked for next Tuesday and they need copy approval. Your report for the senior staff isn't done yet because the Xerox copier is down again."

"Christ."

"I think the copier is down because either the Corotron needs rewiring or the baffle spring is pulled off the shaft."

I stare at her. Helen has trouble getting the top off a jar of coffee. "How do you know that?"

"I looked inside. I also leafed through

"It has always seemed to me that there is something inflamed about the look of Kip's jaw. Something needing only the right environment to erupt into possibly contagious boils."

the manual because I thought maybe I could fix it."

"But you can't. Nobody can fix those things, not even the tech rep, or they would stay fixed longer than ten minutes after he leaves."

"The machines don't stay fixed because we run too much volume on them. That's because—"

"Helen," I say with some irritation, "you aren't by any chance related to my wife are you?"

She looks confused. "I don't think so."

"Good."

On the 6:17, Kip Lowry smacks his knee with his folded newspaper. The evening edition this time. He has pulled his hat brim down lower than usual, and this strikes me as an ominous sign. Visible is his lower jaw, bristling with a day's worth of dark stubble, which gives him a dangerous look. The hints Kip drops about his project in information theory seem to mostly involve such tame and academic things as mathematical formulas and high-speed computers, but it has nonetheless always seemed to me that there is something inflamed about the look of Kip's jaw. Something needing only the right environment to erupt into possibly contagious boils. The 6:17 seems an unlikely environment, but I don't like that smacking newspaper.

"Colder tonight," I say. I am trying to make up for my morning rudeness.

Kip doesn't answer.

"Thought I'd cover the roses, even though it's early in the year for that. No pattern to the weather lately. You should cover yours, too." Kip's roses are the most neglected in Hickory Village, spindly stems and sparse blossoms. This gives me an obscure sense of cheerfulness.

Kip says, "Sandra is leaving me." Smack, smack.

After a pause I say, "I'm sorry." I know this is inadequate, but what else would be better? We don't look at each other.

"After seventeen years," he says. A tear appears from beneath the lowered hat brim, and I am disgusted with myself for feeling a profound distaste. Kip is, I suppose, the closest thing I have to a friend. But on the 6:17?

"You'd think," he says, "that after seventeen years she'd be willing to ride this thing out."

"What thing?" I say because I see I'm supposed to, and despite a strong reluctance to ask.

"Lara Kashinsky."

"Lara *Kashinsky*?"

He stiffens. "Lara just happens to be one of the best random-information specialists in the world."

"I remember your saying that she's brilliant," I say hastily. I also remember her picture in the newspapers at the time of her defection. She must be well over fifty.

"I never thought Sandy would find out," Kip says gloomily. "And now she won't even listen. I didn't plan the thing with Lara, it just happened."

"Ummm."

"These things happen," Kip says. He stops smacking the newspaper and stares out the train window at trees flashing past too fast to be counted.

Janice called, Emily says over a late night brandy. She tucks her hair behind her ears; this is a characteristic gesture of agitation. "There was another burglary, two doors down from her. The police questioned her and Jim and the kids. No clues. They looked in all the soft mud in the yard for tracks, because—"

"I can guess why they looked for tracks without your telling me," I cut in. There's a silence while Emily stares into her brandy. We are sitting up in bed, and the bedside lamp casts a pearly glow on Emily's shoulders, bisected by the lacy straps of her nightgown. At thirty-eight she is beautiful still, and my irritation vanishes and is replaced by affection. Emily's very precious to me although it's hard for me to say so. I have always found it hard. Emily knows this, she's one of the few

women who will forgive it. I reach for her.

She frowns. "Why now?"

"Just because."

"Because why?"

Irritation returns, swamping affection. "Do I need a reason? I want to make love to you. If you don't want to, say so."

"Sandy Lowry is leaving Kip."

So that's what the agitation is about, not the burglary. I see that the Hickory Village phones have been buzzing all day. I see, too, the trickiness of the conversation ahead. When one husband strays, all husbands are somehow implicated in some weird web I have never understood but learned to recognize.

"Ummm," I say, noncommittally.

"It's because he's having an affair with that Russian scientist."

Emily is watching me closely; another "ummm" will probably not do. I decide instead on honesty.

"I know. Kip told me today on the train."

She stops fiddling with her hair, and her shoulders relax, apparently she knew. "I knew. It's that ridiculous house. It's strapped him with debt, and he was looking for some sort of cheap release. Sandy didn't even want such a huge place. Kip only wanted it because he grew up so poor, because his father died when he was three and his mother's eyesight was too poor for her to work, and *her* father was an immigrant who never understood about childhood corrective surgery before it was too late."

"I don't think you have to go back three generations and produce such an elaborate explanation. Anyway, you probably couldn't pin down any definitive reasons. These things happen."

Emily shifts against the headboard and reaches out to set her glass on the night stand. One shoulder strap slides down. Her eyes narrow. "What do you mean—'these things happen'?"

"They just do. Kip and Lara work together on that information project, whatever it is."

"So?"

"So it just happens." Even to me these words have started to sound curiously lame, and I resent it.

Emily punches up her pillow and lies back. "That's irresponsible. It lets everybody off the hook—it lets *Kip* off the hook. Things don't just happen. They're connected, they happen for good and sufficient reasons."

"Emily—"

"There are always *reasons*."

I suddenly think of my secretary, Helen. "Women always want things so definite. Black and white. The world simply isn't that way. Things fall into shades of gray, into unpredictable subtleties. Why can't you just *accept* that?"

I hear, to my own surprise, that I am shouting. Emily turns her head on the pillow to look at me. Perhaps it's a trick of the lighting, some passing effect, but her eyes look like those of a woman I don't know. They are both thoughtful and outraged; violation sparkles in them like stained glass.

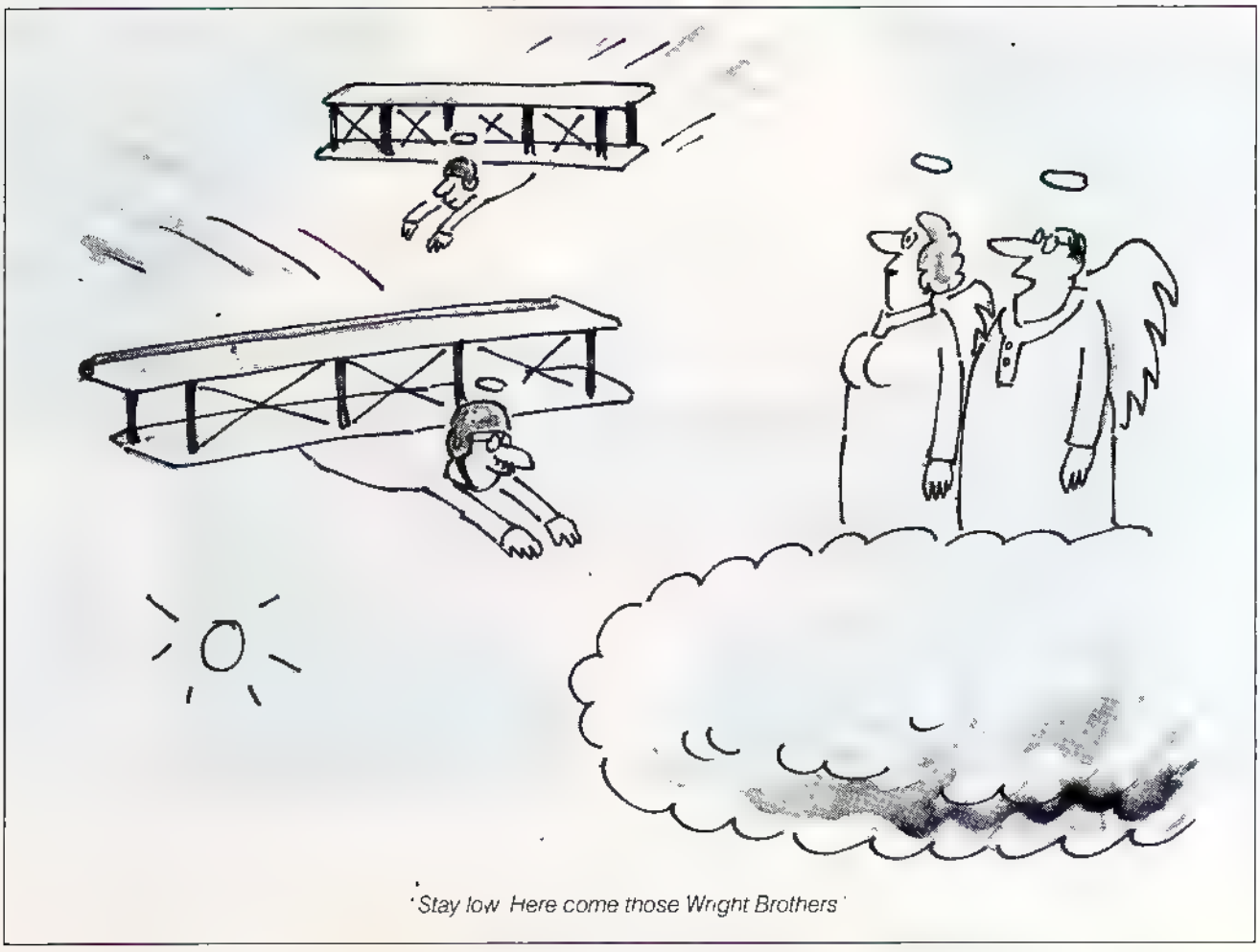
There is a long silence, which slowly turns unbearable. To break the silence without having to break it, I reach again for Emily. She doesn't resist, but she lies passive in my arms while I stroke her. Then she half turns and clutches me almost desperately, and we make very definite and unsubtle love.

The carpet in the corridor outside my office is sopping. Inside the office, water meanders down the walls, drips from the ceiling onto my desk, pools on chairs and file cabinets. As I stand in the doorway staring at this, Helen hurries around the corner, looking harried.

"Oh, Mr. Catton—it's the sprinkler system, they think. That's what was wrong in the lobby yesterday, too. They think that while they were jackhammering the floor someone hit something vital and jammed the whole thing."

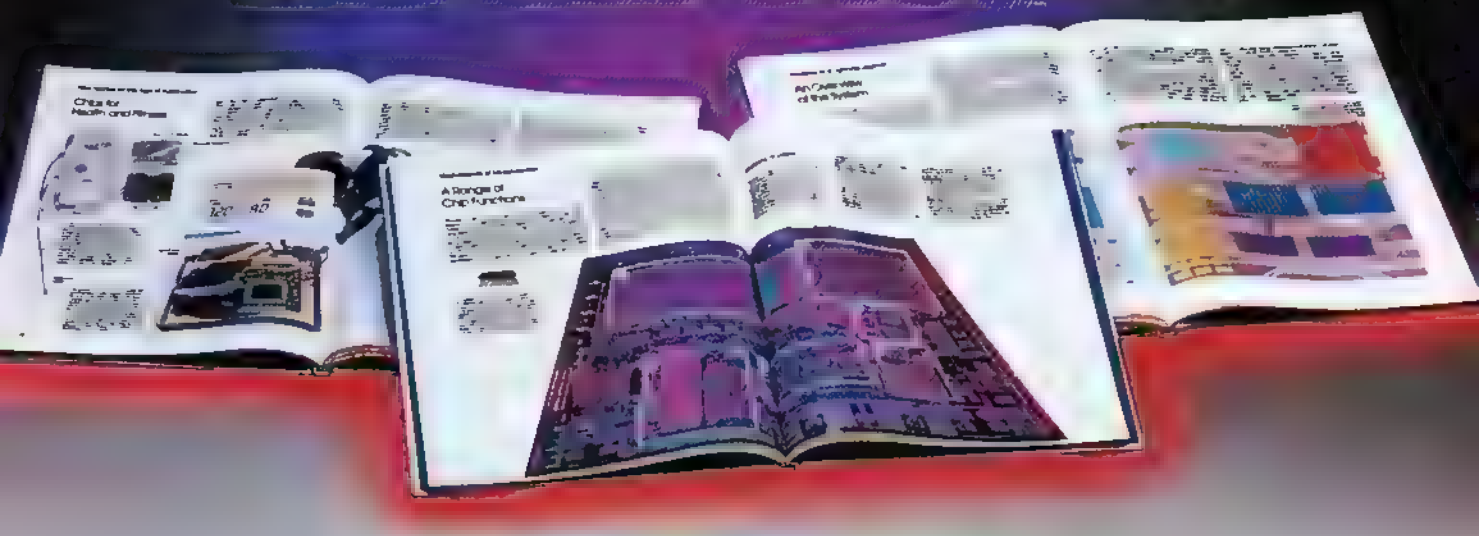
"How long—?"

"They won't say!" Helen cries. I have never seen her so overwrought; she is usually the calmest and most efficient secretary on the floor, making consistent



"Stay low. Here come those Wright Brothers."

SHELF-BASED EXPERT SYSTEM.



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sense out of my chaotic meeting and memo flow. "They think it happened because of a workman who is very inexperienced, he had only been on the job two weeks and three days. His supervisor was out sick because he caught the flu from his little boy, who got it at day-care because the supervisor's wife died in a car crash two years ago and he's raising the little boy alone."

I stare at her. "Helen—how do you know all that?"

She makes a vague gesture, flinging her arms upward as if begging for mercy. "The control thing for the sprinkler system was manufactured in Japan, because it cost sixteen dollars and forty-two cents less per unit to do it there. The engineer said it appeared to be functioning perfectly, because he took it out and tested it, but he won't say how long it will be before you can use your office!"

"Well," I say helplessly—could Helen be having some sort of secretarial burnout?—"we can work around the mess, I suppose. Where did you put my phone and the Hentschel files?"

"In George Schwartz's office. The water isn't too bad in there, and George is out because he took a vacation day to go up to his daughter's college because she's failing two subjects due to excessive partying with Kappa Delta Omicron. But I don't know *why* there's less water in his office than in yours."

"Well," I say, more helplessly than before. "I don't suppose it matters. So long as we can get on with the day. So it goes."

And at my last words Helen calms down instantly, moving rapidly past calm to a set and rigid face, from which she stares at me in silence like stone.

"Look at that," Kip says, his face pressed to the train window obediently, Kip has had a hysterical edge to him for a week, ever since Sandra moved out with their girls.

"John—did you see it?"

"Did I see what?"

"On that other track. A train went by, and it shimmered like a ghost image on TV."

"There are three sets of tracks there."

"No—it wasn't on the third set! You didn't see it?"

"I wasn't looking."

Kip grimaces abstractedly beneath his hat brim. When the brim dips forward I brace myself. Kip has been twirling his self-aggrandizing webs of information theoretical week-message channels. Noise level. Algorithms. Context-sensitive redundancy. If he does it yet again I will change my seat. This time I will. But he says something else.

"Lara called Sandy and told her that I said I wanted to marry her. Marry Lara."

I am somehow not surprised by this. "Do you want to marry her?"

"Of course not. I still care everything for Sandy."

"Did you say anything to Lara that might lead her to think—?"

"Oh, hell, how should I know? You know how it is. You're in bed, you say things—and then women try to hold you to them in a goddamned court of law. Sandy had a fit. She called me after Lara called *her*, and then Lara called on the line in the den, and it seemed I was on the phone with one or the other of them all night. Christ, the hysteria all around."

I can picture it and am meanly glad that Kip lives at the other, richer end of Hickory Village.

At the station he trudges toward the Depot, a bar-cum-restaurant built in an antiquated baggage office for commuters grabbing a quick orange juice in the morning, or a quick drink instead of going home. He has been heading for the Depot every night, I don't know what time he leaves it. I turn my steps in the other direction, toward my street. I am halfway down it when two police cars dash up to the Lindstrom house.

They swerve to the edge of the lawn, black-and-white doors fly open, and two cops run to the back of the house, and two more to the front. The Lindstroms, remember vaguely, are on vacation. I prepare to tell this to the cop approaching me when Kitty Sue Cunningham comes running out of her house across the street and begins babbling in the Georgia accent that somehow becomes thicker each year in New Jersey.

"Ah saw him go in, just sneak around the side of the house, and Ah called the police right away. Ah just *know* he's the one who's been doin' all these *horrible* robberies."

She goes on and on, an anxious, syrupy flow, her eyes never leaving the Lindstrom house, hands twisting the material of a pink dress too young for her lacquered bouffant beehive. The cop listens stoically.

"I look'n' so long at the window because Ah was cleanin' the glass, because of those horrible fly spots every time the weather goes and warms up again and the eggs hatch, and that's all just because a single housefly can lay one hundred fifty eggs at a time, all hatching in just twelve hours—"

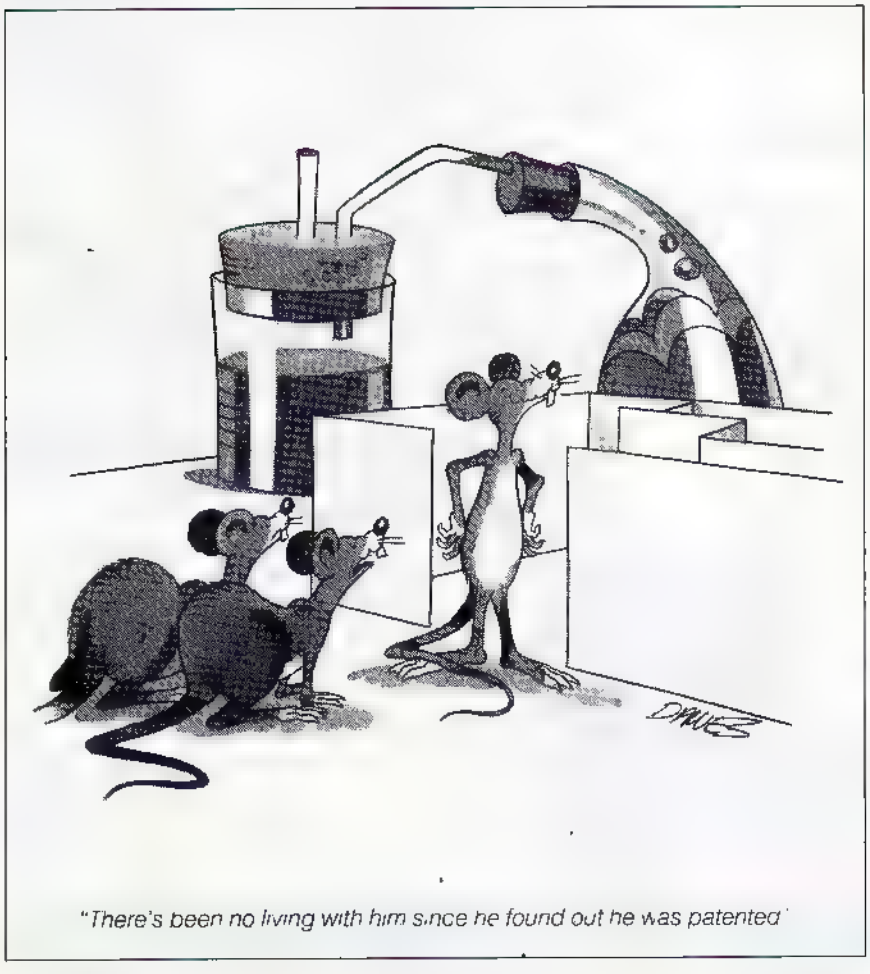
"What?" I say. There is lead in my lungs—"because the rate they get eaten up by birds and toads and all those bitty creatures is so high—"

"Kitty Sue—"

"Nothing," a cop says to me, in a tone I recognize as intentional reassurance. "The lady must have been mistaken. There aren't any tracks anywhere, and in that soft mud there would have to be."

"But Ah saw—"

"No tracks, ma'am," the cop says in the same reassuring tone but Kitty Sue is not listening. She's not even there. A faint bourbon shimmer and Kitty Sue Cun-



"There's been no living with him since he found out he was patented."

n ngham pink dress, Georg a drawl dyed blond ha r, reasons for the mating hab ts of flies—has van shed

Another faint shimmer a second ater, and she s back. ' -m ght have been the Wozniak boy, he's breakin' his poor mother's heart with h s shenan gans, but that s all because—"

The cop's eyes slide toward mine. I see the shock on h s face, but the next moment it too is gone, locked behind a stony b ank cop look—*Make something of it buddy*— that gives him a jawline like an erection

, '—stealin' money from his daddy s wallet, and doin' it more than once. An was told, because— '

Just *because,"* I say—loudly, angr ly, pointlessly and w th fear. Ne ther of them answers, and I walk away trembling a it-tle. I don't look back but go straight home, where I find Emily in tears Wh le she was out at the shopp ng mall, our house had been burglar zed

"They sa d it was random,' I say to Em-y as we prepare for bed Both of us are exhausted from talking to the police soothing the k ds, notify ng the insurance people, list ng the stolen possessions. Who knows exactly what the stolen pos sessions are? Months from now we w l d scover things miss ng that we had for gotten we owned

"Random Emily Not personal They probably didn t know us, or anyth ng about us. You shou dn't take it personal y t happens."

Emily looks up, shimmers, and is gone.

In a moment she is back, yanking her sl p over her head and flinging t into an open drawer I stand comp etely st l un able to speak Perhaps I hallucinated about Kitty Sue Cunn ngham perhaps I am hallucinating now Terr b.e thoughts chase themselves through my head Cerebral arter osclerosis Alz heimer s disease Brain tumors

Em ly, in bra and pant es, begins a frenz ed straightening of the jars and tubes on her dresser "The burglars took my mother s silver cand est cks, be-cause they are worth four hundred fifty-e ght dollars w th silver at current market prices He d dn't know my mother be-cause she died n 1978 and never vis ted us n Hickory V l age because we hadn't moved here yet. He *does* need the money because he's the on y child of a s ng e-parent female-headed household with an average taxab e income of on y s x thou-sand four hundred thirty-two dollars and he dropped out of high school ten months ago because— "

"Stop it!" I shout and seize her by the shoulders She twists savagely away from me, and we face each other at arm s ength, Emily panting hard and I shaking w th a primordial fury I no longer care to control I recognize that there is some el emental abyss here, some deep lack n her that I have a ways despised Almost I could strike her

Emily g ares at me with hatred

The moment spins out, frozen, unbear-ab e Then Em ly breaks putting her hands over her face and start ng to sob

" want things to make sense I just want things to *make sense* "

And the na vete of th s, the sheer ost longing f ls me with a rush of pity t take her in my arms Pity exasperat on—and unaccountably, desire Her breasts through the acy bra are soft against my chest her breath silky against my face The whole moment has taken one of those unpred ctable turns nto sweetness nto grace There is a profound mystery n the circle of ye low amp ght on the f oor, n the random movements of the air n the improbable longings of the fragile and sweet-limbed body n my arms Emily I press her closer.

'No,' Emily says Caref ly she de taches herse f, turns her back, and yanks a f annel n ghtdress over herself bra and a She crawls nto bed and es on the far edge facing away from me , do not understand She does not exp a n

The next day t all happens

K p is not on the tra n enter Jefferson Tower, get on the e evator press the but-ton for the e ghth f oor When the door opens I am on the sixteenth

Jefferson Tower has fourteen f oors I have never seen this place before The e evator faces a bank of copiers and te-ecommunications equipment, as n my bu ld ng but the s gns above them are sheer g bberish HY*CAFK OIG TYH MB K Only the "16" on the l ghted e evator panel makes sense Music f s the air a woman singing softly n g bberish Out of s ght around a corner someone laughs and a sudden nauseating sme , strong enough to make my stomach urch wafts from that direction The l ght s a soft purple. I stand frozen unt l the e evator doors close and the e evator descends t opens on the eighth floor Helen her back to me, s f-dling with the Xerox cop er

I let the doors close again r de to street level, and eave the bu ld ng Some part of my mind notes that I am not remb ng not even when I insert co ns nto the newspaper vendor and buy a morn ng ed t on cannot quite make myse f read on the deserted tra n At the Hickory H. stat on however among the fam ar wooden platform and red-pa nted meta ra ng and late-b oom ng fal w ldflowers in stragg ing clumps I open the paper

STRANGE RAD O BROADCASTS MYSTIF Y C TY

MASS DEL JSIONS SUSPECTED N JP. CO

GT& BHO + P SAYS NEVER AGA N

A woman expensive y dressed in l nen and mink wa ks by me She is talking to herse f with ntense preoccup ed con centrat on can't go along with t be cause of prev ous comm tments and *that* came about beca se '

I squeeze my eyes shut. She sounds like Helen, like Kitty Sue, like Lara Kashinsky. Like Emily. When I open my eyes, Kip Lowry is standing on the station platform in front of me, looking as if he has not slept for days. Wordlessly he puts a hand on my shoulder, a gesture I normally dislike from anyone but Emily, and drags me into the Depot.

I have lost all power to resist.

Inside, we sit at the long bar, which at this hour—ten thirty-two A.M.—is empty of all but a dour bartender polishing glasses. Kip orders a double scotch, downs it with a single snap of his wrist, then orders another. Perversely, the cheap theatricality of this deepens my dazed numbness. We sit for several minutes in complete silence.

Eventually Kip looks around him and says hollowly, "Low information content."

"What?"

"This bar. Dark paneling, stools and booths, mirror over the bar—all predictable. The greater the predictability, the less the new information. This bar is a boring information system.'

I say carefully, 'I hadn't thought of it as an information system.'

"It is. Everything is." He drinks off the second double scotch, motions for a third, and then gives a bark of laughter. 'Everything. All of it out there.'

"Kip," I say, but only because I cannot stop myself, 'just what is going on out. . .out there?'

"What Lara predicted."

"What *Lara* predicted?"

"She warned them," he says, and I am appalled to hear under the strain in his voice another, unmistakable note: dramatic satisfaction. "Them. Us. At the institute. Of course nobody believed her, except me. Then nobody believed either of us, a female defected Russki, and a second-rate researcher."

"Believe what?" I say, and wonder if I am humoring him or believing him myself. Suddenly, without reason, I know that Kip has been fired from his institute. Today, yesterday, or the day before. There has been a scene, one of Kip's messy dramas, and he's making me part of the third act. I want no part of that, after all the rest of it, and I am rising to leave when Kip says, "See this glass?'

I don't answer.

"This glass is an information system. The molecules in the ice cube are in one state, the molecules in the scotch in a very different state. Entropy in this glass is low. Sit down, John.

"I don't want to hear about entropy in that glass!"

"Yes, you do," he says, with utter conviction. "That glass is what happened to you out there.'

I lower myself onto the barstool.

"This glass has low entropy, or to put it another way, the information system has a high degree of order. You know which is the ice and which is the scotch, and where the molecules of each are located, at least roughly.' He stirs the scotch with a red plastic swizzle stick. 'See—there's only a few places the ice can go. Or, in terms of information theory—there are only a few possible messages. High order, low entropy, limited possible states."

Why do I sit and listen? Kip—"

"But even now, even as we speak, it changes!" Kip shouts. The bartender gives us a startled glance. Kip drops his voice, shoves his face close to mine, and says in a stage whisper. 'Watch—don't miss it—keep your eyes peeled every second! Entropy increases!"

"You damned—"

"Yes, indeed. As are we all. Entropy in this glass is increasing. The ice is melting. Soon you won't be able to tell which is scotch and which is ice. All the molecules will be mixed. You won't be able to predict where any single one is. There will be low order, high entropy, an infinite number of possible states. That's what Lara says the Russians are doing.'

Despite myself, I look at Kip's glass and think of vodka. "*What's* what the Russians are doing?"

"Information theory. The whole world's an information system: a glass of booze, DNA, Sandy's angry little mind."

"I don't see it."

"Increase the amount of disorder, you increase the number of the possible arrangements of the parts. Thirty minutes from now, those scotch molecules could be anywhere in the system. Lara says it was a sort of skunkswork project, blueskying it, way apart from their official scientific establishment. They might not have even tried it if the last grain harvest hadn't been such a bust. But it's working, isn't it?" Kip makes a vague gesture toward the door. "They're revving up the flow of chaotic information, artificially increasing it exponentially, and so increasing both the entropy and the number of possible states for the whole planetary system."

"How would you increase the flow of chaotic infor—" I say, and think suddenly of all the high-speed computers in the world—the communications satellites, data links, phone lines, banking networks, electromagnetic broadcasts. Kip is watching me.

"Exactly,' he says softly—too softly. I see once again that some theatrical part of him is *enjoying* this.

"That's all insane, Kip. Just theory. What goes on in the real world—there are physical laws. *Rules*."

Kip smiles slyly. 'Ah, but Lara says they are not mutating just the information. They're mutating the rules by which 'molecules' of information act on each other."

"But that can't be possible. To change the *rules*?"

"Rules are just more information, differently coded. That code, too, can become entropic. That's what cancer is: a DNA code that has managed to gain in entropy, and so in the number of possible states it can produce."

"But—"

"Stop saying 'but.' There's a complexity barrier—Von Neumann proved the equations for that.'

"But—"

Kip picks up my glass—untouched—and pours it into his. Liquid overflows and begins to meander in rivulets along the polished surface of the bar.

"Too much individual information. The old system can't contain it. Complexity is a decisive property. Above some critical level, too much information—even high-possibility random information—becomes explosive. You get an exponential leap in the number of possible states. Lara says the Other Side probably wants a different state. This one is slow economic suicide for them."

The longer Kip talks, the more of what he says makes a weird, distorted sense, just out of grasp, like an object at the bottom of a shallow but murky pond. One second you think you know it's a tire iron, a perfectly familiar object—except that no tire iron was ever bent in that peculiar way. But then, was Kip's abstruse theory any more bent than what had happened in the Jefferson Tower elevator?

Some objection, some half-remembered piece of learning, surfaces in my mind. "Wait," I say, and hear the triumph in my own voice, as earlier it had sounded in Kip's: the perverse triumph of proving a connection wrong. "Wait—no—things don't always tend toward entropy. There's biological life and evolution. Living beings tend to become *more* orderly, not more random!"

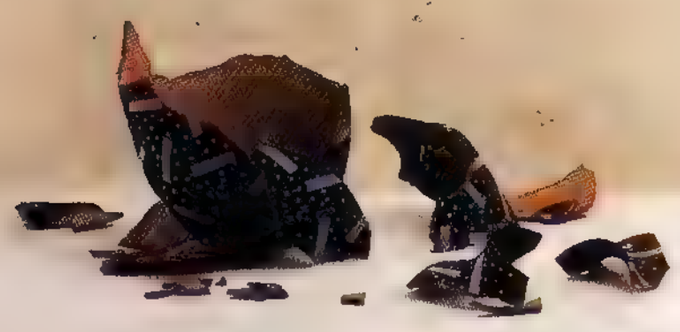
"The complexity barrier," Kip says. His mercurial theatrics have faded by now, and he sits in quiet gloom. "Vertebrates passed it. But you're right—when they did, another force entered the information system—a drive to create order, connections, meaning. And that's why I'm scared shitless."

I am confused all over again. "Why?"

"I don't know." He starts drawing meaningless pictures in the spilled scotch: a flower, a house, a long-tailed squiggle that might have been a sperm. "Who knows? That drive for meaning isn't random, isn't entropic. It isn't high possibility. It seeks the probable. If I write a letter that starts 'Dear Sadny'—spelled *S-a-d-n-y*—the brain will read it *S-a-n-d-y*. At least, some brains would. Not everyone's. Some types of mind just like order

CONTINUED ON PAGE 178

Some decorative objects can make only one sound.



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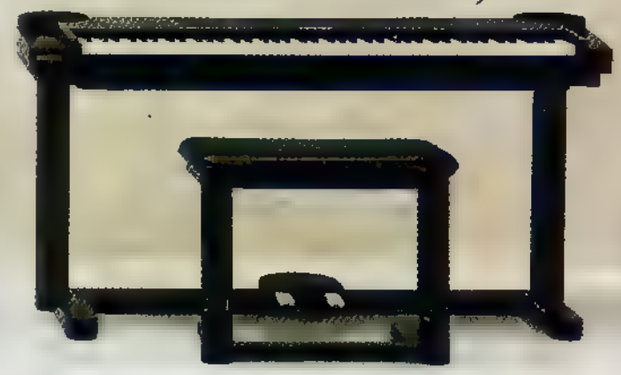

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"A saucer group launched last year in the Big Apple promises to put the excitement back into extraterrestrials."

ANTIMATTER

UFO UPDATE

Have you been to too many stuffy UFO conferences lately? Do they seem a deadening blur of reported sightings, photos of silver discs, and scholarly tomes? Do the UFO organizations MUFON (Mutual UFO Network, Inc.) and CUFOS (Center for UFO Studies) strike you as cold and intellectual, with simply too little pizzazz to accomplish anything important?

Take heart. A saucer group of a whole different stripe has whirled onto the horizon. The New York Center For UFO Research (NYCUFOR), which was launched in the Big Apple last year at a splashy conference attended by 800 people, promises to put the excitement back into extraterrestrials. "The movement gets pretty dry," says Michael Luckman, NYCUFOR's founder. "I want to get people stirred up."

The way Luckman sees it, even though MUFON and CUFOS have done invaluable service, they fall short in motivational skills. "They've done a great job of research," he says. "Whenever I need to know the latest UFO news, I plug into MUFON's computer myself. But they're conservative. After almost twenty years, MUFON has only seventeen hundred members. I'd like to have five thousand to ten thousand in two years. I want to reach the average citizen."

Luckman believes he's just the mover and shaker for the job. A free-lance PR man, he says he has worked with such heavyweights as Jane Fonda and the Chicago 7's David Dellinger on the National Mobilization Committee to End the War in Vietnam. His interest in UFOs began in the Seventies when he was publishing a newspaper called the *New York Daily Planet*. He started a section on UFOs and eventually came to believe that they carried visitors from other worlds.

Then one day, serving as PR man for a UFO conference in Manhattan, he observed something peculiar. Both he and the keynote speaker, physicist and well-respected UFO researcher Stanton Friedman, spent time with TV reporters. But in the end Friedman got little coverage while Luckman appeared on every station. That experience showed him how desperately the movement needed a publicity expert. The idea of starting his own UFO group gradually evolved.

Convinced that the media are the message, Luckman plans to start putting ads on independent TV stations in the wee hours of the morning, between one and six A.M. Some of the airtime has been donated, and Luckman's organization is raising funds to pay for production. He's also planning nationwide lecture tours of college campuses. The money NYCUFOR gleans from these endeavors will then be used to finance barnstorming rallies across the country.

The sooner it all happens, the better, stresses Luckman. With the earth's degenerating condition, we have perhaps 25 years or fewer left to live. "There's an increase in earthquake activity," he says. "There's a tear in the ozone layer. The weather is screwed up everywhere. Contacting extraterrestrials may be our only hope. Their intelligence compared to ours might be like ours is to a worm's. If we place ourselves in their trust, they may be able to replenish the planet or, if necessary, evacuate it."—*MARK TEICH*

Ten years ago while medi-tating psychotherapist Roger Woolger suddenly saw a grisly scene from the Middle Ages. He had flashes of a medieval city in chaos, people running everywhere, blood, severed limbs and bonfires of human bodies. The recalls visualization techniques later enabled Woolger to uncover memories of his life as an Italian mercenary burned at the stake centuries ago by Catholics during the Albigensian Crusade.

Recalling that former life Woolger says helped explain his innate suspicion of Catholicism and his fear of fire. Reasoning that others might benefit by discovering what happened to them before this lifetime, Woolger began using guided imagery exercises to uncover his patients' past lives.

Woolger, who details his experiences in *Other Lives, Other Selves* (Doubleday), says he's not interested in using historical facts to check out whether tales of purported former lives are legitimate. "What's important is to use past life therapy to get to the bottom of anxieties and traumas carried into this life so they can be brought to a conclusion."

Woolger denies any conflict between past-life psychotherapy and his training as a Jungian. "Jungians believe that we are much more than we consciously know."

Psychologist Terence Hines of Pace University in New York agrees that past life therapy can help patients but not because reincarnation is real. "You can use guided-relaxation techniques to put people into heightened states of suggestibility so they may believe they are reincarnated, but it's clearly fantasy," he insists. "Even if you make a patient believe he was a rock in a sandstorm in Arabia in the twelfth century, it can help establish a therapeutic rapport between therapist and client." — Sherry Baker

The now, the here, through which all future plunges to the past

— James Joyce

The great gurus of India supposedly control incredible powers called *siddhis* to perform miracles. Levitation, astral projection, ESP and healing are powers they traditionally possess. Sai Baba, the last of these great miracle workers, today lives in the town of Puttaparti. Millions of Indians revere Sai Baba as a god, and the sixty-two-year-old guru doesn't deny the claim.

Sai Baba is best known for the way he makes objects materialize out of thin air. Some witnesses say he has been seen in two places at the same time. Others contend that he can produce out-of-season fruit from thin air and cause holy ash (called *vibuti*) to form on photos placed on shrines across the land.

Now comes *Modern Miracles*, a book by Erlendur Haraldsson. A psychologist at the University of Iceland, Haraldsson made eight trips to India to meet Sai Baba and collect evidence for the holyman's claims. Haraldsson himself watched closely while the guru made small objects materialize in his palm to illustrate points. The psychologist also collected eyewitness accounts.

In Bangalore, Bombay and practically every town in India, devotees found shrine rooms with photos covered with *vibuti*. Haraldsson says. A mere examination of the pictures gave no clue as to whether the *vibuti* appeared paranormally or was placed there by other means. In some cases the ash would be seen both inside and outside the picture frame.

Despite his reservations, Haraldsson concludes that some of the phenomena may, at least, be genuine. Not everybody, however, is convinced. Raymond Bayless, a parapsychologist in Los Angeles, saw several films of Sai Baba performing his miracles in 1979. "I saw no evidence for paranormal powers, and everything I saw could be explained normally," he says.

What of the *vibuti* that materializes in the homes of Sai Baba's followers? Bayless investigated a case reported by a family of devotees. Bayless reports, "I don't think we have to look outside the family for an explanation."

— D. Scott Rogo

"There is a rhythm to the universe and I'm finding it's plugging into that rhythm."

— Tina Turner

The tarot deck has been used for fortune-telling since the fourteenth century. But now, says Denver psychic and numerologist Daphna Moore, students of the occult can use the cards to energize their pineal glands, developing psychic powers in the process.

Moore's ideas, explained in her new book *The Rabbi's Tarot* (Hughes Henshaw Publications), are based on the Major Arcana, 22 tarot cards with Hebrew letters. The cards, she says, received publicity thanks to a mysterious rabbi who lectured on the tarot throughout Europe in the late nineteenth and early twentieth centuries. Moore also says it's appropriate that a rabbi unlocked the multileveled meaning of the tarot because Jewish masters of the occult put their ageless wisdom into tarot symbols to preserve it through the centuries.

According to Moore, the knowledge in the Hebrew tarot can be accessed through the subconscious mind. "If you are drawn to one of the cards," she says, "it is because the archetypes are speaking to your higher self. By meditating on the color and musical note associated with your card and by studying the rabbi's commentary, the meaning of the card will become clear. As that happens, a slow transformation begins."

For example, she says, the magician card represents the sex force. "By studying the magician, we learn to take the energy we use in the sex act and raise it to energize the brain's pineal gland. That opens higher levels of consciousness, enhancing psychic skills."

Paul Kurtz, head of the Committee for the Scientific Investigation of Claims of the Paranormal, is doubtful that tarot cards contain any mind-altering secret knowledge. "Moore is a self-proclaimed psychic making an uncorroborated subjective claim," he says. "Without hard data to support it, the whole idea is pure speculative poppycock."

Poppycock or not, however, Moore insists that *The Rabbi's Tarot* contains the metaphysical secrets from which all occult magic comes.

—Sherry Baker

It's rancid but edible. That's what they're saying about a huge ball of butter recently unearthed in a peat bog in Ireland. What is most unusual about the butter ball, however, is that it's more than 1,000 years old.

According to Tony Candon, director of the Roscrea Heritage Center in County Tipperary, Ireland, the size and age of the butter ball make it one of the most unusual finds of its kind. "We know from documentary sources that dairy produce was buried in bogs for preservation from the early Middle Ages until the nineteenth century," says Candon, who has been investigating the find for the center. "This particular ball weighs nearly one hundred pounds and was found at a depth of five feet, which indicates that it is approximately one thousand years old."

The butter ball, stored in what Candon believes was the stomach of a cow, was preserved by the moist conditions in the peat bog. According to Glen Doran, the anthropologist at Florida State University who recently discovered the world's oldest preserved human brain matter in a watery burial ground in Florida, the find is another example of the "incredible preservation potential" of saturated soils.

Candon, now in search of funding to continue his analysis of the substance and its container, has declined to taste the butter himself but says that one Irish journalist who snitched a bite said it tasted like athlete's foot. "I'm still trying to figure out how she knows what athlete's foot tastes like," he says.—Rick Boling

"I believe in the inheritance of skills and crafts—the inheritance of memory. They find now that if a snail eats another snail, it gets that second snail's memory."

—Robert Graves

"Among the five senses, smell is, unquestionably, the one that best gives the idea of immortality."

—Salvador Dalí

"But there can hardly be a doubt that we are descended from barbarians."

—Charles Darwin

DOUBLE

CONTINUED FROM PAGE 65

This work moreover has moved forward at lightning speed The original cloned sheep came from embryos just eight cells large Now cloning of 16 cell and 32-cell embryos is routine and Willadsen has already gotten calves from the blastocyst stage containing about 120 cells He then went on to clone the first cows and Jim Robl has cloned rabbits When researchers can clone adult cells from these species and others the benefit to the animal industry will be immense The fleeciest sheep the beefiest cattle the fattest pigs the swiftest horses, the most overflowing cows—all could be produced exactly as ordered on demand Moreover cloned farm animals could be used to produce valuable drugs Wielding the tools of gene splicing scientists are now trying to develop transgenic cows that will secrete large quantities of pharmaceutical products in their milk the way transgenic mice already make a human heart drug Using cloning techniques biotech companies could turn out these transgenic animals—walking drug factories—by the thousands

With so much progress on the animal front cloned humans may be the next goal A major catalyst breakthrough work in the field of in vitro fertilization The technique came to fruition on July 25, 1978 with the birth of Louise Joy Brown the first baby to start life in a laboratory dish Patrick Steptoe the obstetrician who attended Louise at both her conception and birth died last February But Robert Edwards the scientific half of the famous team continues his work

This is the only in vitro fertilization center in a stately hall says the gray-haired Edwards who at sixty-two is the perfect lord of the manor Walking through Bourn Hall Clinic on the outskirts of Cambridge one would be hard put to find a greater contrast between a building and its use Housed in a redbrick mansion built during the reign of King James I in the early 1600s it was taken over by Edwards and Steptoe in 1980 Now in these Jacobean rooms with their dark wood paneling and crystal chandeliers women lounge on overstuffed Victorian sofas while their babies are created upstairs

In his office Edwards carefully rests a tea service and a plate of biscuits on his 150-year-old Victorian desk An ideal host, he easily negotiates the complexities of pouring milk tea and sugar As he relates his story however it's clear that life was not always so sedate

Long before he met Steptoe Edwards (who adamantly opposes the principle of human cloning) had hoped to develop a technique for in vitro fertilization To accomplish his goal he needed to harvest ready-to-fertilize eggs—eggs that had been produced during a time in the reproductive cycle known as ovulation To understand how to harvest eggs at the optimum period he began studying the reproductive cycle in mice Specifically he gave his animals a hormone needed for ovulation and waited to see how long it took an egg to grow

In this way Edwards learned that mice had a specific program of ovulation one so regular you could set your clock by it Later experiments showed the same held true for 12 other species including man The human egg virtually always ripened 37 hours after the hormone injection occurred Using this knowledge Edwards had managed to ripen human eggs in culture by 1965

But *collecting* the eggs proved to be a problem The only ones Edwards could get were from ovaries that had been removed during hysterectomies He tried to fertilize some of these but only a few of them worked If his research were to progress he decided he must have fresh eggs taken directly from a woman at the time of ovulation

I looked everywhere for a gynecologist who could get eggs out easily he says All my colleagues said it was impossible He still remembers the day in 1968 when he sat in the library at Cambridge University reading a paper by Patrick Steptoe on a new technique for reaching the ovaries using a laparoscope a narrow tube with a built in optical fiber light for viewing

"It was a lovely little paper he says in his dramatic breathy voice I called him up and he said that yes you could use laparoscopy for getting in and out very easily and quickly

The two soon formed a team and Edwards was now able to use laparoscopy to extract human eggs Now that Edwards had fresh eggs to work with he could begin fertilizing them with donated sperm For ten hectic years he drove the 200 miles from Cambridge to Steptoe's Manchester office knowing all the while that if he did not get there on time he might lose the eggs We had blastocysts we knew how they grew we knew how to orchestrate it It was an unbelievable time he says

By 1972 though the duo faced an even bigger hurdle—placing the embryos back in a woman's uterus Nineteen things can be right says Edwards but if only one thing was wrong it was a failure After giving the woman hormones to superovulate (produce extra eggs) fertilizing the eggs in the lab dish and replacing the embryos in the uterus all the embryos died Finally in 1976 they found that the very hormone they were giving to stimulate ovulation was destroying the pregnancies When Steptoe was sixty-five and about to retire they switched back to the natural cycle, and bingo it worked" says Edwards Eventually other re-

searchers even developed techniques for preserving embryos by freezing them in liquid nitrogen before they were ultimately placed in the uterus.

The ethical and legal reverberations of this work, of course, continue today. The rights of unborn, frozen embryos, the fate of spare embryos, and the rent-a-uterus custody fights are issues that society has not yet resolved.

But the most earthshaking effect is still to come. By combining the techniques of nuclear transfer with those of in vitro fertilization, the technology for cloning human embryos is now online. The nucleus of a single human embryo could be transferred into a human egg cell, then grown to term in the womb of a surrogate mother. Using the technique of serial transfer developed by Gurdon, scientists could duplicate the same embryo over and over again. As Willadsen puts it, "If we can do it in cows, it is just a matter of time before it can be done in people."

But chances are that in the future we'll be able to clone not just embryos but human adults. Scientists from around the world have already begun to learn how to trick adult body cells, normally differentiated to perform specific tasks, into going backward in time to an early embryonic stage when all the genes were fully turned on and all things were possible. Some of the greatest progress in this area has been made by Di Berardino. In cloning experiments on frogs, she used adult red blood cells to create tadpoles that ate, survived for as long as a month, and formed hind limb buds, indicating that a wide spectrum of the dormant genes had been reactivated. The trick she used was placing the red blood cell nucleus in an egg cell before it had fully matured. "Before the egg is mature, it must go through certain metabolic changes that occur over the course of about twenty-four hours," says Di Berardino. "And it turns out that this is a conditioning process for the adult cell nucleus." In contrast, when she used fully mature eggs, the embryos that resulted lived no longer than a day.

Determined to see this through to the end, she is now exposing the adult cell nucleus to even earlier stages in the development of the egg cell. "We are working on the basis that we are going to be able to improve our techniques and hopefully activate the entire genome [all the genes in a cell]," she says. "We hope we can do this in a few years."

Once researchers have the power to turn back the clock, making an adult cell young, the age of cloning will be here. But even if clones never walk among us, the medical applications of cloning will be vast. First of all, cloned embryos could be used for what has been referred to as spare-parts surgery. In the same way that fetal brain cell implants have been used to treat people with Parkinson's disease, cells and tissues from a very early embryo could fill in and patch up body parts wherever they are needed. By day 25 of embryonic development, Edwards points out, the tissues that make up the heart, brain, bone marrow, skin, and other organs have already started to differentiate. These could be removed from the embryo and grown in cell culture. In this way heart cells could be used to repair the heart, brain cells, to repair the brain, and so on.

Gurdon takes this concept further still. He proposes growing pulsating human hearts, lungs, livers, arms, and legs in laboratory dishes. "The principle of a specialized cell being able to give rise to almost all the other specialized cells in the right organization really has been proved," he says. In his most recent work he has gone from injecting nuclei into eggs to injecting isolated genes from turning on the whole genome to make a new individual to controlling a tiny piece of it. For example, he and his co-workers have located the small piece of DNA that controls a gene for muscles. Work like this, he says, will pave the way for identifying the factors that get inactive genes started up again. In this way, human beings may learn the tricks that allow primitive animals like salamanders to grow new tails or certain types of frogs to regrow limbs. Scientists are already using growth factors to grow skin cells in large sheets in the laboratory. But Gurdon believes this is only the beginning. Although he is not ordinarily given to speculation, the possibilities delight him. "You could regenerate your teeth. Think of how useful that would be," he says. "And you could grow arms in culture and give them to people who've lost them. That would be marvelous. I do think the ability to regenerate will probably come."

"The report stated that the egg was fertilized, cell division began, and in three days the embryo was ready for implantation. If true, then the first glimmering of a person had been cloned."

But not soon enough for Paul Segall, visiting scientist at the University of California, Berkeley. "To grow organs in this way one would have to learn how to artificially induce every kind of tissue. I'm not saying it can't be done, but it might take fifty or a hundred years."

Rather than partial solutions, Segall advocates a total head-to-toe approach using a body clone. This would mean taking a cell from an individual, transferring it into an enucleated egg, growing the embryo in culture for a few days, and then putting it into a surrogate uterus. About six weeks in to embryonic development, the collection of primitive cells called the telencephalon, the forerunner of the higher brain, would be removed and frozen. In this way, Segall says, the body clone "would never develop a brain capable of anything more than secreting hormones and commanding the most basic vegetal bodily functions. It would never perceive pain or love. Without any portion of the higher brain, the body clone would be less human than the fish that graces our dinner table."

Once the body clone was grown to the appropriate size by intravenous feeding and hormone injections, it could serve as the equivalent of a brain-dead organ donor, only in this case there would be no rejection of the transplant. Since the clone would have exactly the same genetic makeup as the person from whom it was derived, all its parts—from the facial features to vital organs—could be replaced as though they were the person's own, which they would be.

Even the aging brain could be treated, says Segall, by replacing the damaged or diseased cells with new ones from the telencephalon that was set aside during early embryonic development.

Of course, growing the body clone would require a uterus. Here there are several possibilities. One, suggests Segall, is growing the clone in the womb of our closest primate cousin, the chimpanzee. While this may sound farfetched, animals of one species have already been carried to term in the uteri of related species. Another is ectogenesis, bringing babies to term outside the uterus, perhaps in a womb of glass. Scientists have grown rat embryos in glass dishes to the point where their hearts were beating. Recent ground-breaking research indicates another means that may be a lot closer to fruition—a machine-assisted uterus. According to their report, the first of its kind, a group of Italian researchers took a human embryo that had been fertilized in vitro and actually got it to implant itself in a uterus that had been removed during a hysterectomy.

Although the scientists kept the uterus functioning for only 52 hours, they believe that advances in organ preservation techniques will eventually allow them to keep the uterus and its implanted embryo going for a much longer time. In fact, they say, "future complete ectogenesis should not be ruled out."

How to sustain the body clone once it is full-grown? Segall, who made headlines two years ago when he chilled a beagle named Miles and then brought it back to life, suggests freezing. "Cloning will reach its zenith," he says, "when we

The Artist

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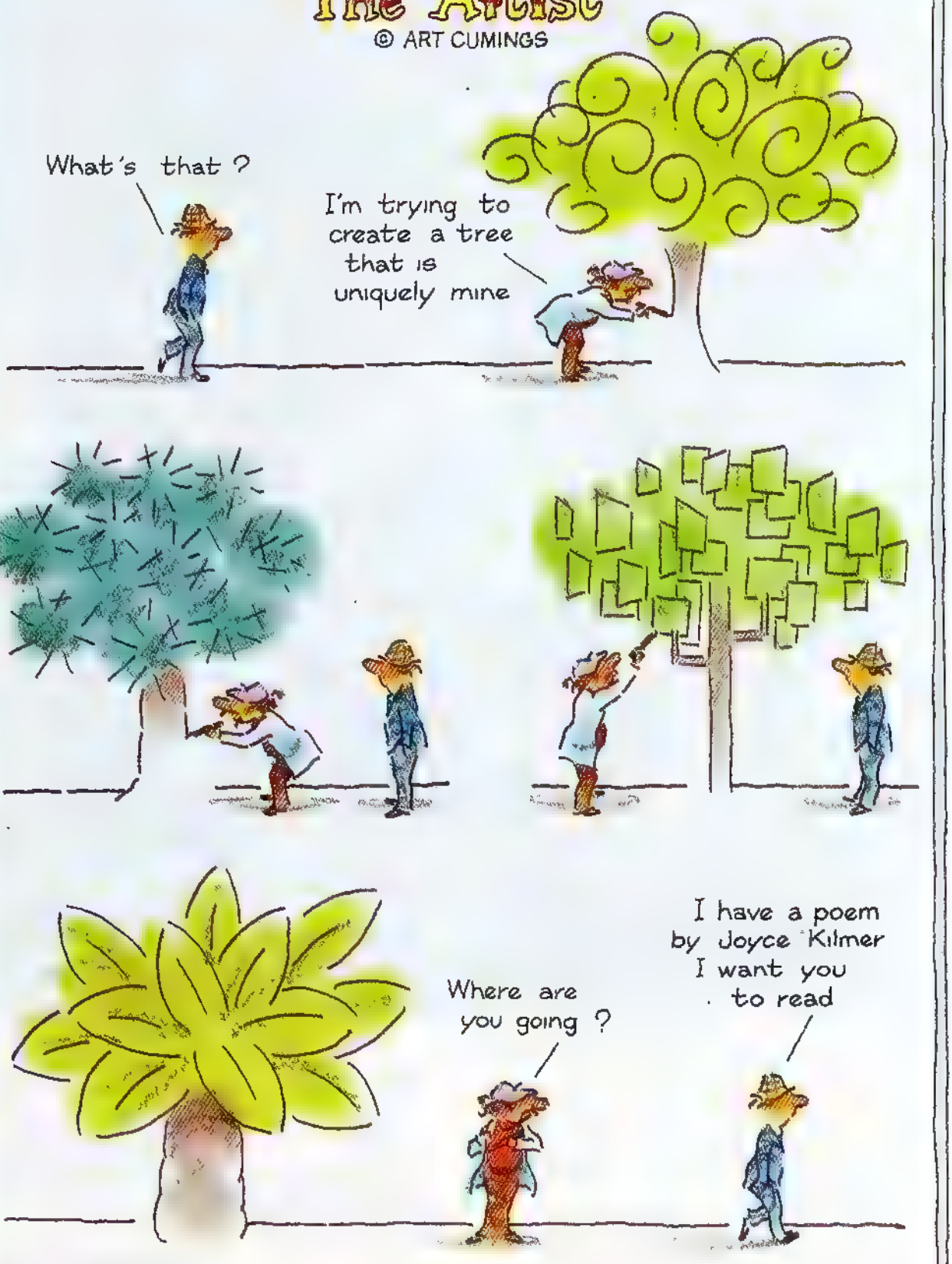

WHAT DID HOW DO TO DESERVE BEEFEATER?
BEEFEATER

lot more worrisome than the idea that somebody might be carried away and do something in the laboratory

Indeed as with any powerful new technology the potential for abuse is enormous We could for instance breed legless people mental defectives or cross species monsters with prehensile tails to do society's dirty work One could envision armies of replicated Rambos or a dictator churning out clonants at one with his world-conquering vision, or a Utopia "perfect in every respect down to the uniformity of its inhabitants

But persuasive though these objections may be they will never override the eternal human quest for immortality As Robl says "If cloning can be done somebody will probably try and do it If so one day soon some self appointed Prometheus is bound to steal the fire of creation and bring it to the human egg

According to one renegade scientist that day is here Landrum Shettles is the enfant terrible of human reproduction After making a name for himself with his early ground breaking work on human reproduction and embryonic development he became embroiled in a series of controversies In 1973 five years before Louise Joy Brown became the world's first test tube baby he claimed to have fertilized a human egg in a laboratory dish But the possibility of pregnancy ended when the cells were confiscated by his boss Raymond Vande Wiele and Shettles was forced to resign from New York City's Columbia-Presbyterian College of Physicians and Surgeons where he had practiced obstetrics and gynecology for 26 years He created more headlines and controversy when he backed Rorvik's book on cloning as being credible and propounded a method of sex selection that many other scientists dismissed as dubious

Then in 1979 while working at Gifford Memorial Hospital in Randolph Vermont he launched another bombshell a brief article complete with pictures in the *American Journal of Obstetrics and Gynecology* entitled Diploid Nuclear Replacement in Mature Human Ova with Cleavage According to the report he had removed the genetic material from a human egg cell and replaced it with the nucleus of a human spermatogonium the precursor of the sperm cell Because the spermatogonium contains a double set of chromosomes it is a complete blueprint for the individual The egg was fertilized cell division began and three days later the embryo was at the morula stage its cluster of cells ready for implantation If the paper was true then it meant that the first glimmering of a human being had already been cloned

"I remember getting a phone call from Bob McKinnell "one of the pioneers in the field] saying Guess what Shettles says?" recalls Di Berardino But like most of her colleagues, D Berard no was skeptical Shettles never presented evidence that the egg was enucleated she says nor did he use genetic markers that would have proved that the sole parent of the embryo was indeed the transplanted spermatogonium

Again Shettles got into trouble with his superiors The hospital's board of trustees asked him to refrain from further experiments In 1981 taking an offer to set up an infertility clinic in Las Vegas he left once more At age seventy nine without a laboratory in which to test his ideas he optimistically carries on Work recently carried out in Australia he declares, shows how cloning can be done

In that study a group of scientists led by in vitro fertilization expert Alan Trounson was able to fertilize a human egg by injecting a single sperm cell under the zona pellucida the outer covering of the egg For Trounson the success of this work means that men with poor quality sperm or a low sperm count would be able to father a child For Shettles the take-home message is a little different Years ago he says he found that there were some human sperm about 1 to 2 percent of a normal semen sample that had unusually big heads Looking further he found that they contained a diploid number or two sets of chromosomes instead of the usual haploid or single set Shettles reasons that if he could isolate and immobilize one of these big headed sperm he could inject it into an enucleated egg using Trounson's technique Thus could Adam father himself To clone Adam's wife Shettles would choose a rapidly dividing cell from the uterus the genetic material from that area he says, has the best chance to start a new life

"I'm a farmer's son from the South" says Shettles who has never lost the folksy drawl of his native Mississippi "I know that if you take a plant put it in good soil and give it some water it will usually take And if you put that nice big-headed sperm in a nice egg with all its reserves well that is like putting it in fertile soil If I had a big laboratory and could sit right down I know that could do it

But even if Shettles succeeds Adam will need one more thing to complete his dream a way to clone the contents of his brain Memory transfer is not a total fantasy says Segal "The idea is that memory is stored in the brain in some physicochemical way that is knowable he says And we know how memory is stored in the computer When we reach the point that we can read the information in the brain and write it onto a computer then we will be able to program the clone brain to develop with the information in the computer The mind boggles Cloned brains and memory transfer The individual raised to the nth power Not just serial immortality but parallel infinity Where will it all end?

In the beginning Adam made Adam The Bible, the new one, said it best ∞

LESSER GOD

CONTINUED FROM PAGE 88

Around the turn of the century Leduc had been studying osmosis the phenomenon by which molecules move through a membrane from a highly concentrated solution to one that is less concentrated When living cells osmose or draw materials through their membranes they are able to receive nourishment and pass out waste

While studying the phenomenon Leduc found that certain types of inorganic material when placed in solution actually grew into structures surrounded by osmotic membranes They bore an amazing resemblance to the structures of life Once the membranes were formed in fact the inanimate substances began passing molecules back and forth much as if they were alive These growths Leduc reported in 1911 "put forth bud and stem and root and branch and leaf and fruit" Indeed he declared his structures looked like plants right down to the microscopic level They reproduced, went through a period of youth in which they moved like animals and then grew old and died "We are at a loss" Leduc said "to define any line of separation between these mineral forms and those of organic life In the end the scientists of Leduc's day including Louis Pasteur lumped the behavior of osmotic growths with the disproved notion of spontaneous generation They dismissed the phenomenon as unimportant, and it might have stayed buried forever if not for Zeleny and his crew

Convinced that Leduc's findings revealed something valuable about the essence of life its organization Zeleny set out to reproduce some of these experiments himself Following the models described by Leduc so many decades before he took broken fragments of solid calcium chloride and manganese chloride and dissolved them in solutions of inorganic salt As he sat watching his "primordial soup" over a period of days he saw a variety of A-life forms sprout Some of these entities resembled plants while others had the traits of fish or worms

According to Zeleny in fact depending upon the exact substances used his osmotic growths included stems leaves flowers buds fins amoebas and worms Many of his creations even had what looked like cilia, the tiny hair cells used to help a whole range of animal species transport nutrients and wastes from one place to the next What's more Zeleny's smooth lifelike structures seemed to live and breathe like living cells he says His crystalline creatures transport matter across their membranes absorbing the components they need for nutrition and expelling the rest as waste They also repair themselves by growing new membranous cells to replace those that rupture and "die" And they exhibit the uncannily lifelike ability to reproduce by spawning buds Finally if a crystal

grows out of the water into air, its entire structure changes that is it evolves

But perhaps most intriguing to Zeleny and his collaborators, George Klir of the State University of New York at Binghamton, and Kevin Hufford of Broome Community College in Binghamton, is these creations' capacity for "autopoiesis." Like living cells and organisms they are literally able to orchestrate a continual turnover of their parts. "A living cell," Zeleny explains, "exists by virtue of a complex set of processes that synthesize proteins, enzymes, lipids, and more. These processes renew the individual elements of the cell thousands of times during its lifetime Yet throughout this turnover, the cell maintains its distinctiveness and autonomy." This lasting unity and wholeness in the midst of continual turnover defines Zeleny's creations as well

Are these structures *alive*? "There is no sharp division, no precise limit where inanimate nature ends and life or animate nature, begins," Zeleny says "What we can say is that there seem to be major organizational themes. The shells leaves stems and protuberant flowers of nature are apparently not just properties of organic living matter but are old and more basic." It appears that any matter under certain conditions, can take on the characteristics of biological life

The philosophical questions emerging from Cairns-Smith's and Zeleny's work are profound If inanimate matter can organize itself in biological form is it innately different from organic life? Will organic and inorganic creatures ever merge, making a being that combines attributes of both?

And if we view life as a system of organization as opposed to a collection of "stuff," then might we begin to unearth the living in places we never dreamed of? Finally, how much of what we now see in the fossil record were actually osmotic growths and other forms of nonbiological life?

To unravel some of these mysteries Zeleny and colleagues are currently modeling the patterns of osmotic growth on the computer screen Over the short term they hope to dissect for instance, the process that makes the growths shoot up in a vertical direction, the means by which the growths slow, thicken, and eventually stop; and the mechanism that controls a growth's ultimate decay. If, as they hope, their work leads to a full understanding of the life cycle of the osmotic growth they may eventually be able to alter these forms at will

But though clay and crystal can simulate life, perhaps even to the point where we consider them alive, will they ever be endowed with the gift of consciousness? Will the A-lifers entities ever be organized enough to actually feel and think?

According to physicist Freeman Dyson of the Institute for Advanced Study in Princeton, New Jersey once we learn a bit more about consciousness, there is no reason why not After all, these structures are driven by the power of chemical energy much as we are "The beauty of chemical energy," Dyson explains, "is that it's so enormously flexible, and it can serve so many different purposes at once. It's a good way of storing energy, a good way of releasing it in a controlled fashion, and a good way of transferring it from one point to another That's why life makes use of it" And, he adds, that's why it might be used to drive other, novel life forms as well

In fact Dyson even envisions an ALF created to survive the phenomenon of heat death a future time when the entire universe, colder and far less energetic than it is now would be winding down Dyson's suggestion, inspired by the thoughts of Cambridge University astronomer Fred Hoyle an evolving, intelligent, even emotional black cloud "What I envisage as the structural unit of such a creature," he says, "is simply dust grains, probably made of iron or some convenient stuff, charged and working on one another with electric and magnetic forces. One can imagine enormously complex structures built out of these things. What would correspond to a muscle or a nerve synapse? I haven't the faintest idea It's an open-ended system just as the organic fluids we're made of are. The electromagnetic forces would give you a means of tying it together coordinating it. It could be just as complex, even more complex than what we see around us now."

"Anything could be alive: batches of chemicals, traffic patterns, electronic impulses moving through computer chips. All that counts is that it has the right organization, the right logic."

Whether future ALFs are gas clouds or clays they will eventually interact As biologists point out complex living beings are in fact colonies of a number of simpler organisms. Humans, for example are actually loosely knit communities of many different creatures such as bacteria, viruses and one-celled organisms living together symbiotically. Our "I" is in truth a "we" What's more, even larger organisms must learn to deal with a more complex whole as they cooperate to find a niche in which to live avoid predators, and pursue prey.

A-lifers must therefore focus not just on the creation of single living individuals but on group behavior as well Ultimately the most likely approach to creating complex ALFs will be to mimic nature's methods of organization The first step will be to develop simple single-cell ALFs, the second, to proceed with the process of bundling them together into vast patterns that will someday make more elaborate ALFs capable of behaviors as complex as those of man A vast synthesis of all the patterns would lead to a geosystem as multifarious as that of the earth To uncover these patterns, A-lifers are imposing the laws of Darwin on computerized artificial worlds. One such system has been created by Craig Reynolds of Symbolics Inc., a firm that makes a specialized computer for artificial intelligence and graphics design

Reynolds got to wondering if there would be a way of creating dynamic herds of animals—schools of fish, flocks of birds and so on—without tediously drawing the trajectory of each individual member every step of the way He knew from his own observations and research that the synchronized flying of real birds is not produced by any master controller or head bird Rather, each member of the flock flies solely in reference to its individual perceptions, both of the other birds and of the world at large. *Why not create computer birds?* he thought. He'd let them loose and see if they'd flock together by themselves.

So he created a computer program featuring what he called bird-oid objects, or boids. He gave his boids three specific instructions Avoid colliding with other boids, fly in the same direction and at the same speed as those close by; and stay together in a group.

When he let his boids out of the cage, it seemed almost magical There was no way to predict the flight path of any individual boid nor was there a constant position that any one took up with respect to the others. Nonetheless, they flew in unison, as if they were just one big happy family that had flown together a million times in the past. Their spontaneous flocking behavior emerged even though it hadn't been explicitly programmed

In addition, two unexpected things occurred At one point a solitary boid left the flock and flew some distance away, but then—as if it realized that it had lost the flock—it curved around in a loop and raced back to join the others Nothing in the program called for this but there it was nevertheless a stray boid mimicking completely on its own, the flight paths of its avian cousins in the real world.

At another point a boid, contrary to its program flew right into an obstacle. It bounced back, fluttered for a moment as if stunned then zoomed ahead to catch up with its brothers Reynolds hadn't programmed that into his boids, either

Reynolds has since speculated that more advanced computer animals might one day be able to perform with even greater independence. He suggests, for example, programming a whole set of cartoon characters to talk and interact with one another, then turning them loose—within the confines of the computer—to live it up

"It might be interesting to build charac-

ters that would be complex enough to generate their own story line," Reynolds says. "It might be tough to make this work, but it wouldn't be impossible." In Reynolds's wildest fantasies the day might come when ALFs could mimic the antics of Roger Rabbit and the other toons, making up their own scenes, living their own lives, writing their own dialogue, and perhaps doing away with the need for screenwriters.

Today, however, the most sophisticated computer world can be found not in Toontown but at UCLA, where researchers have developed a colony of artificial animals and plants. These LA ALFs do it all: birthing, eating, gaining weight, reproducing, aging, dying, becoming extinct. They even evolve adaptive changes through the force of natural selection.

This ALF paradise is the brainchild of David Jefferson at UCLA's department of computer science. In the early Eighties, when he was a junior professor at the University of Southern California, Jefferson read and was inspired by Richard Dawkins's book *The Selfish Gene*. In this groundbreaking work, Dawkins set out three conditions that must be met in order for evolution and natural selection to exist. One, there must be reproduction; two, there must be reproduction with variation (in other words, offspring must not be mere clones of their parents); and three, there must be competition for scarce resources.

Jefferson and colleague Charles Taylor became convinced that computer programs could embody these qualities. "A living creature is born, grows, moves and interacts with its environment, including other animals—and possibly learns about its environment. It competes ecologically with other animals, it produces variant offspring of itself, and it dies," Jefferson says. "It hit me that all this is true of programs, too. Programs can be born; they can be created, they can be placed in an environment and interact with it and with other programs, and they can reproduce variant offspring of themselves."

To prove his point Jefferson wrote rabbit programs, fox programs, and a grass-growing program. The grass was the bottom of the food chain and provided the stage on which the drama of the ALFs—the foxes and rabbits—would be played.

Unlike the boids, which had no individual identifying features, the foxes and rabbits varied from one to the next in age, weight, and initial genetic endowment. A rabbit's speed gene, for instance, determined whether it was fast or slow. Its birth gene determined the size of any litter it might produce. (To keep the program simple, Jefferson made reproduction a solo affair requiring only one parent to produce an offspring.) All these features were interconnected and mutually dependent, just as in real life. Out in the world a rabbit's weight is an approximate measure of its readiness to give birth. The heavier the rabbit, the more likely it is to produce offspring. And so it is in the program. In the real world fast rabbits are better at avoiding attack. And it works that way in the program, too. The fast-running gene gives rabbits a better chance of escaping from foxes. But this speed exacts a penalty. A speedy rabbit has a higher metabolism and so must eat more grass. If grass becomes scarce—because there are lots of other fast rabbits escaping the foxes and eating, too—the rabbit may starve to death.

The normal behavior for an artificial rabbit includes rules such as:

1) If there is a fox in your square, look around for a safer square and run there.

2) If there is grass in the square, eat some grass.

3) If you weigh enough, reproduce.

And for foxes, such laws of the jungle as:

1) Find rabbits in your neighborhood.

2) Eat them.

3) Reproduce.

So much for some of the ground rules. Jefferson divided the environment into numbered squares of grass, created 50 rabbits and three foxes, and let them loose. He thought he'd learned enough about predator-prey relationships to know how the contest would proceed. The two populations would go through regular ups and downs, the predator slightly out of phase with the prey. He figured the rabbit population would increase first. Then the foxes, with more to eat, would grow more numerous. Then the foxes would decline because there were fewer animals to eat, and the rabbits would increase again. On and on. If all went according to plan, this cycle would repeat itself indefinitely.

> *"Computer programs acting as rabbits and foxes could mutate in response to the whims of fate, setting the stage for natural selection—the route to species survival on Earth."*

But it didn't work that way. "Sure enough, I got this rise and fall," says Jefferson. "But then I got a crash. The rabbits went extinct and the foxes starved to death shortly afterward. Or sometimes the foxes would go extinct, and the rabbits, having no enemies, would soar in population until their numbers had reached the carrying capacity of the system." Within one or two cycles, it seemed, Jefferson always wound up with massive extinction. He couldn't do anything about it, and he didn't know what was going on.

Then he happened to read a treatise on ecology that dealt with this case. Its author showed that any random or unpredictable influences played havoc with the classic oscillating population model. As it turned out, Jefferson's animals, based in part on a code from a random number generator, had random behavior built into them. Programmed to imitate the vagaries of real-world chance, they threw their computerized Eden into a frenzy, perpetually going extinct. Says Jefferson: "I was finding through my program something that serious biologists had known all along."

As a further refinement to the program therefore, Jefferson gave his rabbits and foxes the capacity to mutate, a means of responding to the harsh whims of fate. A fast parent could give birth to a slow offspring and vice versa. The stage was thus set for natural selection—the route to species survival, at least on Earth.

Now when Jefferson runs his code, the random number generator controls mutations. Initially, all rabbits have the slow gene, but eventually a mutant rabbit that runs fast is born. Slowly, according to data flashing on the screen, a shift takes place. The fast rabbits are escaping and reproducing; the slow ones are childless and eventually dinner. The brutal geometry of Darwinism has unfolded. In the beginning, 90 percent of rabbits were slow; now 90 percent are fast.

"It's the population of foxes that's driving this," explains Jefferson. "It's a case of natural selection in action—an advantageous gene being selected for in response to environmental stress."

While Jefferson's creatures possess many of the attributes of life, they are not, he confesses, alive. To generate the ghost in the machine, he notes, his programs must be more complex. "When trying to simulate the real biological world," he says, "one of the barriers I hit is the temptation to have boundaries between what is alive and what is not. In my simulation, for instance, the animals move while the environment stays still. In reality, however, the world is totally fuzzy, and this distinction is indefensible. My long-term goal is to create a program of complex activity where the creatures and the environment truly mix." Jefferson hopes to create "an organism as complex as a bacterium" one day.

Some experts say this has already been done with plants. The prize for the most lifelike ALF at the recent Los Alamos convention went to Przemyslaw Prusinkiewicz of the University of Regina in Canada and Aristed Lindenmayer of the University of Utrecht in the Netherlands. Their program re-created the growth of a number of flower species by imitating the chemical signals that control branching and budding in nature. By combining information on the growth cycle with the species' complex geometries, their program generated a startling horticultural display. The graphics were so realistic that they left even the meeting's ultrasavvy computer audience wowed.

Peter Oppenheimer, a research scientist at the New York Institute of Technology's

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Computer Graphics Laboratory, has been designing sophisticated ALF plants "in silica" as well. To make his organisms as lifelike as possible, Oppenheimer has literally given them genes.

Oppenheimer's genes are simply codes entered into the computer. Each code in turn has a graphic expression on the computer screen. Indeed, just as the human blue-eyed gene will provide its owner with vivid blue eyes, Oppenheimer's color, size, and shape genes provide his computer plants with visible identity as well.

To design computer trees, for instance, Oppenheimer has invented a series of 15 computer genes, each coding for its own trait. The traits, which taken together define an entire tree, include such things as the angle between the main stem of a tree and its primary branches, the amount of helical twist in the branches, and the color of the bark. "The result," Oppenheimer explains, "is a computer generated color video image of a tree or other organism."

But Oppenheimer was not content simply to spin the roulette wheel of genetics, creating one random organism after the next. To truly simulate life, he decided, he would need to confer on his organisms a specific level of fitness to determine the likelihood of survival, just as evolution does in nature at large.

Oppenheimer decided, however, not to provide his forms with objective parameters of fitness—for instance, small trees succumbing while large ones prevailed. Instead, he established "subjective criteria" based on his own aesthetics. "I let the visual appearance determine which organisms would survive and which would not," explains Oppenheimer, who is an artist as well as a scientist. "I chose the organisms I personally wanted to see evolve."

Oppenheimer readily admits that his technique is suggestive of man playing God. "That's a significant part of the process," he notes. "If we're making artificial life forms, we do become God in a way. We become involved in the process of evolution, and there's no doubt that as we create artificial life forms, we will create them with the attributes that we ourselves want to see."

As far as Oppenheimer is concerned, A-lifers will ultimately combine subjectivity with creativity to generate forms that are eerily familiar yet flagrantly unique. "If, while creating artificial life forms, you borrow certain principles from nature but ignore or even violate others," Oppenheimer says, "the result will be a series of hybrids lying somewhere between the natural and the artificial. In fact, I don't even believe there's a distinction between the two realms. In the future, we may wind up with a continuum of hybrids. These life forms, though disturbing, would add new meaning and spirit to the very notion of life."

Whether in or out of the computer, scientists will eventually create ALFs in a wide variety of forms. As their technology evolves, they will create creatures as complex as themselves. The ultimate ALF, most A-lifers say, would challenge the very meaning of life as we know it today.

This supreme A-life form, in fact, already has a name. The universal constructor or UC would be able to make anything: tools, machines, spares to heal its own busted parts; it would be able to reproduce itself. And when it became obsolete, it could create its evolutionary descendants as well.

"The universal constructor won't be just important; it will be explosively revolutionary," says its advocate, Richard Laing, now a consultant who trained in linguistics, mathematics, computer science, and biology and was formerly the head of the logic of computers group at the University of Michigan. "In the next fifty years—even twenty years—there's going to be tremendous pressure to create a thing like this."

Exactly what such a device would be constructed of is naturally still far from clear. It could be wholly ALF or a hybrid of biological and nonbiological components. It could contain the seminal work of today's genetic engineers and AI researchers taken to the *n*th degree. But regardless of the details of its design, it would clearly change forever man's relationship with the world, his fellow men, and life itself.

"The universal constructor would be able to make anything: tools, machines, even spares to heal its busted parts. And when it became obsolete, it could create its own descendants."

Obviously such a device—or more likely a vast hierarchy of devices—could till the soil, handle all manufacturing, mine for minerals, and in general make a warp-drive leap to a different phase of the industrial revolution. It could, in short, produce everything the human species needs to survive. Says Laing, "Everyone could have a Rolls-Royce every day of the week."

UCs would do all the work and leave us leisure time to occupy with all those things we'd rather be doing now—like watching more TV. Not to worry; we could build entertainment UCs to tell us jokes, do party tricks, and serve canapés. When the party was over, we could have our universal chauffeurs drive us home on highways made and maintained by universal transit workers. The world would, in fact, become a vast, fully automated network of UCs, each specialized and adapted to its own evolutionary niche.

Though creating this network might seem complex, Laing says it is not. "Because it's a universal constructor, it can build another machine exactly like itself," he says. "You'd have to build only the first one by hand. Once you did, the UC and its progeny would produce unlimited quantities of anything you might want at essentially no cost. It would be the last machine we need ever build, and whoever built it first, well, it wouldn't matter who did it second. It would be like coming in last."

One of the UC's first creations might be universal therapists (UTs) to help all the billions of people in last place deal with this—and the boredom of so much free time.

Of course, people would wind up chatting with UTs, who would be, after all, artificial life forms. Pretty much like talking over your problems with the microwave. Indeed, ALFs, UCs, and UTs will be life forms alien from us. And if we do a good enough job of designing them, says Laing, "we will find ourselves cohabiting the universe with an alien race. The ultimate outcome would be unknown. We could dominate them, they could dominate us, we could coexist as separate species, or we could form a symbiotic relationship."

The precise future of the ALF, in fact, is unknown. "This is a classic problem in science," says John C. Higgins of Brigham Young University. "Do you understand all the implications beforehand? Quite often you don't understand the physics of something until you've done the experiments, but by then it may be too late. There was this ghoulish wager at Los Alamos as to whether or not the atom bomb would ignite the whole atmosphere. We lucked out in that case, but what if someone creates an artificial organism that takes over the whole ecosphere?"

To dedicated ALFies, however, the rewards are worth the risk. The challenge, they declare, is to give evolution a little nudge, assuming at least implicitly that man's inquisitive, problem-solving, relentlessly creative mind is as much a part of the grand plan as the grosser aspects of human anatomy are.

"To what extent are you tied to your biology? Is your loyalty to your biology or to your mind?" asks Hans Moravec of Carnegie-Mellon's Robotics Institute.

Echoes Farmer, "Nature is taking its course by giving us a brain to do these things. Making A-life is beautiful in the same way that having kids is beautiful. It's amazing, but when you think about it, having kids is creating new life. You make it, and you watch it emerge, and you see the joy and the richness and the beauty of it, and you have the feeling of something that transcends your own consciousness, something that goes beyond me. It's my analog to believing in God. I believe that there are scientific laws in the universe and that living organisms have emerged to perceive them. That to me is the ultimate beauty and reality and truth. And so if we use those laws to create new life, I can't see that as a bad thing."

LIZARD MAN

CONTINUED FROM PAGE 114

attack while on his way home in his chauffeur-driven limousine.

Dick's widow sold the estate to an India-born owner of oil supertankers by the name of Ravi Tikkoo for $3 million. He eventually sold the estate after a severe slump occurred in the tanker market during the oil embargo and petroleum shortages in the Seventies.

The current owners are real estate and hotel tycoon Harry Helmsley and his wife, Leona, who paid $11 million for the estate in 1983. The federal government indicted the couple this year for income tax evasion—to the tune of $14 million. They're alleged to have fraudulently deducted the cost of a marble dance floor, a swimming pool enclosure, and other Dunnellen expenditures as business expenses.

SUMMARY: "This house is like the Hope Diamond," Linda Dick said when she put the house up for sale after her husband's death. "It has brought bad luck to everyone who has ever owned it." At that time Linda Dick's real estate agent, Duff Associates president Louis Duff, scoffed at the bereaved wife's assessment of the mansion. "I wouldn't argue the point with her today," he now says, however.

According to Preferred Properties president Marjorie Rowe, who has handled two sales of Dunnellen Hall, "It hasn't been a particularly happy house." She adds, though, that she doesn't believe the house is cursed.

RECOMMENDATION: If nothing else, there may be a moral here. If you plan to buy a multimillion-dollar home, expect financial difficulties. At the moment most investigators and interested parties believe the owners' money woes are mere coincidence. Suggest watching what happens with the Helmsley couple. Follow up with reports on next owner.

If you're in Connecticut and want to initiate an investigation, call the Greenwich Chamber of Commerce for directions to Round Hill Road. If Dunnellen Hall goes on the block yet again, consider buying, if you dare.

FILE #1978-TK
THE BACKYARD BAFFLER

DESCRIPTION: The backyard baffler is any unexplained physical (natural or man-made) phenomenon in your area that has two or more witnesses. No UFO or Bigfoot sightings permitted.

All previous and current investigators must admit they are stumped. Knowledge of the baffler should be locally confined and not widely related on television, by newspapers, magazines, or any other national media.

OBJECTIVE: To nominate a backyard baffler, send us a complete description of the phenomenon. Include when, where, how, and by whom it was discovered, names of previous (or current) investigators, their affiliations, and their conclusions, why it's a mystery, why you think it should be resolved, and why an investigation of your baffler should have priority over others.

Send your report to Backyard Baffler, c/o *Omni*, 1965 Broadway, New York, NY 10023-5965. All entries must be postmarked by November 15, 1988, and become the property of *Omni* magazine. Open only to residents of the United States and Puerto Rico.

A panel of anomaly investigators will review all suspects, and each will determine the finalists in his specific area of research. The finalists will then be transferred to Eastern Michigan University sociologist Marcello Truzzi, director of the Center for Scientific Anomalies Research. His choice for Mystery Case #10 will be based on what he considers to be the best presented, most intriguing, most unusual baffler—and the one that has the most scientific importance.

REWARD: We will sponsor an investigation of the winning baffler, the results appearing in a future issue of *Omni*. The lucky reporter will win a "mystery weekend." Where? That's the mystery. ◻◻

INTELLIGENCE

CONTINUED FROM PAGE 38

"brains" is confused by something in the world, the total function of the machine is impeded only slightly. The other brains remain intact.

Brooks endows his "insects" with the simplest skills first. Like species on the evolutionary ladder, the robots gradually become more sophisticated, taking on one skill at a time. One of the first skills his robots acquire is "runaway," based on a system that detects objects, calculates collision and evasion trajectories, and sends the appropriate signals to the wheels and motor. An insect with no skills but "runaway" would move if a threat appeared but otherwise would spend its life dozing quietly. To motivate the bug, Brooks might add "wander," the program that instructs the robot to move randomly around the room. If a robot programmed for "runaway" detects an object while it's following a path set by "wander," "runaway" will execute an alternate path that steers clear of the object. Once the robot's back in the clear, "runaway" will allow it to return to its original course.

A third skill might be "explore," which enables the robot to scan the distant neighborhood (five or ten yards away) for empty spaces. When "explore" detects an empty space, the spirit of adventure takes over. "Wander" is turned off, and the robot heads for the empty space. When the empty space has been entered, "explore" gets bored, turns "wander" back on, and starts to scan the area for new empty spaces.

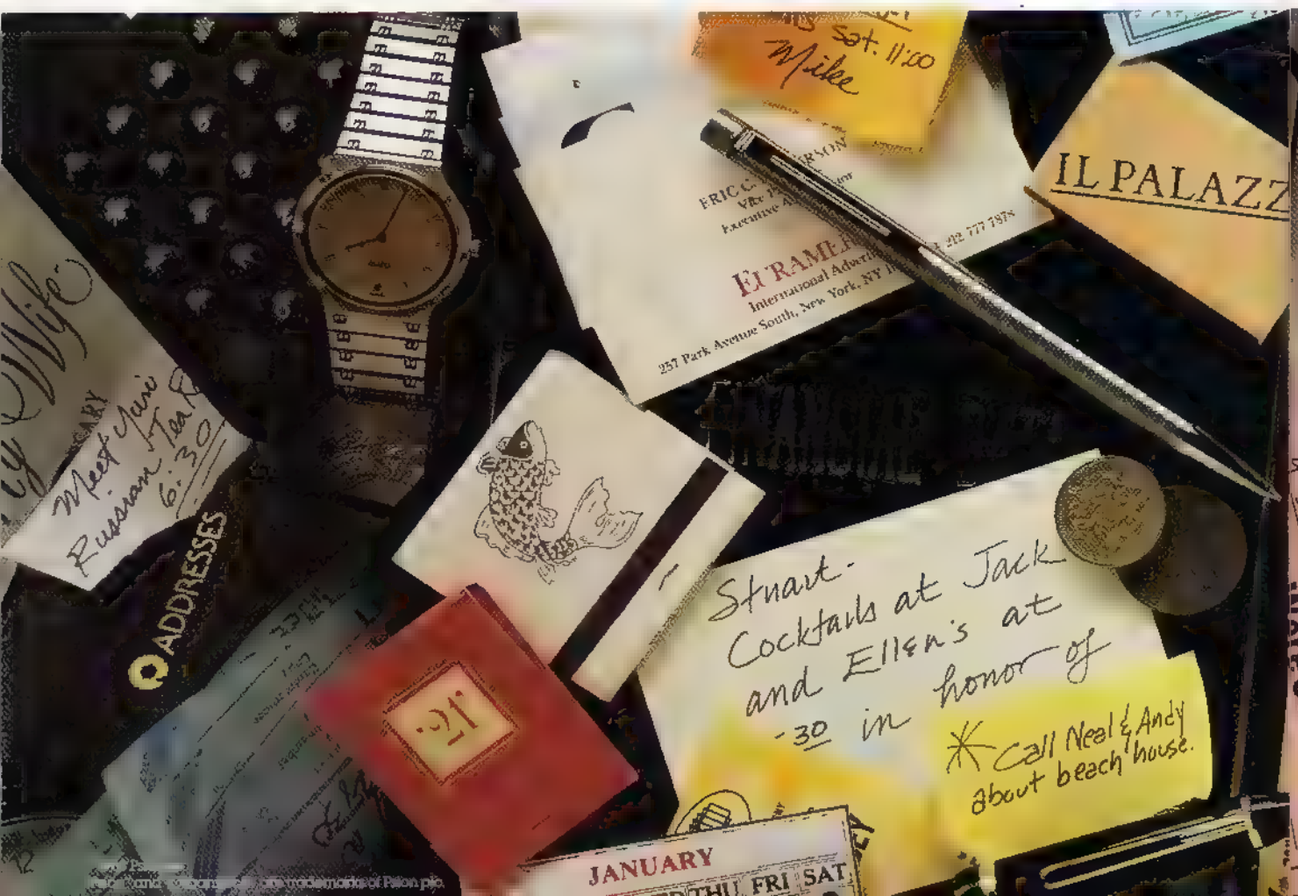
All sorts of variations on these behaviors are possible. For instance, to investigate a wide-open space, "explore" might set the bug moving in a spiral motion.

These behaviors are the robot equivalents of basic social skills. Imagine that a second robot starts running around inside our insect's domain. Whichever sees the other first will change its path accordingly, demonstrating that as simple as Brooks's insects may be, they at least understand common courtesy.

As more and more skills are developed and added to the bugs' circuitry, these robots might eventually become as competent at dealing with the real world as reptiles or even small mammals are. And as their skills increase, their social interactions, too, will become increasingly complex. In fact, according to Brooks, colonies of robot bugs will eventually prove more useful to humans than single, large ones. For instance, he has proposed that NASA explore the moon and other planets with tens of thousands of "artificial fleas." Weighing a few ounces at most, he says, these minirobot bugs could hop across the entire surface of a distant planet, exploring every nook and cranny of its terrain.

Once millions of tiny robot bugs are set to work exploring space and cleaning the home, Brooks says, we may be faced with a full-blown robot ecology composed of semiautonomous robot organisms that would be independent of man and interdependent on one another. Such creatures might someday occupy niches that are inhospitable to biological creatures. Spiderbots inhabiting the walls of skyscrapers, for instance, could stake out territories, form dominance hierarchies, conduct courtship rituals, and forage for wastepaper, as well as serve human beings by keeping the outside walls of the buildings clean.

Brooks's bugs can thrive outside his lab. In fact, if you're interested in owning a robot bug of your own, turn to page 201. There you'll find instructions for building *Omni*'s Photovore, an artificial insect that illustrates the principles of Rodney Brooks and the MIT lab. Designed especially for *Omni* readers by Jonathan Connell of MIT's Artificial Intelligence Laboratory, the Photovore is so sensitive to its environment that it literally qualifies as a robot pet. While it is simpler than the robots designed by Brooks, it should allow you to befriend an artificial insect and observe its life and times firsthand. ◻◻



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FREAK SHOW

CONTINUED FROM PAGE 122

cal critics of the early twentieth century, Bourne wrote with unusual discernment about the inner struggle of those who carry a stigma "I was good at my lessons I was devoted too to music, and learned to play the piano pretty well But I despised my reputation for excellence in these things and instead of adapting myself philosophically to the situation I strove (and have been striving ever since) to do the things I cannot do." In the same way Lisa's goal, through surgery is to be "plain enough to be left alone"

As humanitarians, we applaud her choice Behind the emergence of modern humanitarianism, however we are able to detect a more disturbing set of attitudes a belief that suffering plays no necessary part in normal life, a tendency to define normal life precisely as the absence of suffering even a willingness to insist that suffering has no right to exist

The other side of humanitarianism is a certain coolness even a certain tolerance toward those who lack the essential requirement of a good life

The identification of a good life with a normal life has widened the distance between the normal and the abnormal and made the position of abnormal individuals increasingly anomalous As the material requirements of a good life have steadily expanded so has the category of disabilities that allegedly bar so many people from enjoying it If a good life means a good job a good education, a good place to live, a good understanding of our own advantage a clean bill of health, and a highly developed capacity to "relate" to others, what happens to people who fail to meet these requirements? What happens to people who suffer from birth defects, from chronic disease from crippling or disfiguring conditions of one sort or another, from mental ailments that impair proper functioning, from antisocial or sociopathic tendencies, or simply from the debilitating effects of old age? Do we really confer a favor on such people by keeping them alive or allowing them to be born in the first place? Once we accept the definition of the good life as a life free of trouble and pain, it is hard to resist the implacable logic that would relieve trouble and pain by relieving those who suffer of the burden of life itself

As long as the development of technology lagged behind humanitarian aspirations, we had to acknowledge practical limits on our ability to improve the quality of life. But medical advances together with a general improvement in the standard of living have encouraged a belief that adversity can be brought under human control Hardships formerly accepted as inevitable have yielded to modern scientific and technological progress This technological conquest of nature has revolutionized our expectations and encouraged a redefinition of the good life

With the advent of genetic engineering amniocentesis in vitro fertilization, organ transplants and other technological advances the abolition of limits becomes a practical not just a hypothetical project At this point the inner logic of humanitarian sentiment begins to reveal itself as the kindness that kills.

According to Justice James Andersen of Washington State's Supreme Court the "new stream of emerging opinion" among doctors, judges and bioethicists, 'typically couched in the language of caution and compassion,' flows in the direction of an insistence that 'for an increasing number of patients the benefits of continued life are perceived as insufficient to justify the burden and cost of care' Opponents of the 'emerging stream' of medical opinion have pointed out that the concept of a right to die can easily become a duty to die

Daniel Callahan, founder of the Hastings Center and widely regarded as the nation's foremost authority on medical ethics, has recently begun to argue that a rapidly aging population will strain health-care facilities to the breaking point and that life-extending medical care should be denied to those who have passed a certain age This reasoning can easily be applied not only to the elderly but to anyone who is broadly described as incompetent, as well as to fetuses with genetic abnormalities

What will the world look like when we have finally succeeded in ridding it of freaks? That it will be a world lacking in variety almost goes without saying But a loss of diversity some say, will be a small price to pay for the elimination of unnecessary suffering No doubt there is a case for diversity, for the obligation to respect the incredible proliferation of plant and animal life on Earth, in all its unexpected forms and to give nature a free hand in its endless creativity even when it does not appear to serve humanitarian or even recognizably human ends But there is also a case for technological progress which extends human control over nature and makes it possible for us to lead fuller, freer lives than our ancestors

So we are told The trouble is that we have freed ourselves from dependence on nature only to become more and

more dependent on our own technology. The point is not that this technology is unreliable (though it often is) or that it produces undesirable side effects that are difficult to foresee. The point is that it threatens to weaken the very bodily and mental capacities that are the essential conditions of being human—seeing, hearing, memory, our ability to walk long distances or to endure extremes of heat and cold. Living in an increasingly enclosed artificial environment of plastic and glass, in overheated or air conditioned buildings we have re-created for ourselves a kind of womblike dependence. We speak of the ability to function as the definition of normality, but in fact none of us can any longer function without the technological life support systems we have come to take for granted.

The promise of genetic engineering is that it will create a race of perfect human beings. But the search for perfection cannot stop with genetic engineering. It demands the technological redesign of human life as a whole. It demands the creation of an artificial environment designed to protect us from every form of discomfort, from drudgery, from disease, from the effects of old age—in short, from all the natural inconveniences and hardships that make life less than perfect. If our aim is to make ourselves less dependent on nature and ultimately to provide ourselves with total security, we have no choice except to make ourselves totally dependent on machines.

The irony of this logic—this attempt to engineer the good life through technological control of our environment—is that it will eliminate freaks only by turning us all into freaks. If freaks are people in whom bodily and mental capacities are in some way impaired—people incapable of normal functioning'—then we will all become freaks in the end, even in our eagerness to rid the world of abnormal human beings.

In Lewis Mumford's book *The Pentagon of Power* there is a photograph of an astronaut in his space capsule, which Mumford—a distinguished historian and critic of technology—entitles "Encapsulated Man." The photograph shows a pathetic little humanoid, "the final product of evolution?" encased in a plastic placenta and wired to his controls by what can only be described as an umbilical cord, since it seems to be attached to his navel. Here is the most advanced product of a technology capable of carrying man to the moon but also of reducing man himself, as Mumford says, to a scaly creature more like an oversized ant than a primate. Ant or embryo, the photograph suggests both images at once—the figure in the cockpit is clearly a freak. And so, of course, are we all, wired to our machines, the last freak show. ∞

BODY

CONTINUED FROM PAGE 28

brain tumors between 1970 and 1982. (A subsequent inquiry had established a definite connection between the Orsay researchers' cancers and their work with mutagens.)

On June 18 Jacob, the Institute's president, told journalists that the most probable hypothesis was that the cancers were unconnected, representing nothing more than a statistical fluke. He cited evidence that approximately one case of cancer occurs each year in every group of 400 individuals. Because about 200 people had worked in the two affected labs in the ten years since they opened, he said, the Pasteur cancers could well be a coincidence.

In July Bernard's commission held a press conference to announce a second investigation. This one, to be conducted under the auspices of the International Agency for Cancer Research (IARC), would be an epidemiological study evaluating the risk for cancer among researchers in molecular biology labs in Europe and America. Furthermore, Bernard confirmed that the five cancers represented four different tumor types.

This proved to be Bernard's last statement on the matter to the press. A second press conference scheduled for late January 1987 was pushed back to March and then to May before being postponed indefinitely. His commission has continued its investigation behind a veil of secrecy. While scientists and spectators await firm answers, the apprehensions raised by the Pasteur cancers have fueled plenty of speculation. Malpiece's family successfully sued the French social security agency to get his cancer designated an occupational disease. For his part, Bernard cites two factors he believes preclude the cluster from being a mere coincidence. "The first," he says, "is that the researchers are young, and cancer is much more frequent after age sixty. The second is that they were not very common cancers."

Alfred Neugut, an oncologist and epidemiologist at Columbia University's Comprehensive Cancer Center, says he's not impressed by the cluster itself. "It's hard to believe that something specific could cause so many different types of cancer." Neugut admits, however, that three lymphomas and two sarcomas among 230 people in a six-year period is quite high. Given that the rate of non-Hodgkin's lymphoma among forty-year-olds in the United States is about 3 in 100,000 people per year, he estimates that the incidence at Pasteur was about 66 times higher than would be expected.

Over the six-year period in which the cancers were diagnosed, the researchers tested more than 100 industrial products for toxicity and mutagenicity. It has been proposed that the substances could be more carcinogenic than currently believed. Neugut suggests that exposure to chemicals commonly used in molecular biology labs could have a cumulative effect on the immune system, suppressing its action and creating a vulnerability to different kinds of cancers. A study done in the late Sixties on members of the American Chemical Society showed that chemists who work with many of the same solvents used by the Pasteur biologists have an increased risk for lymphomas—the type of cancer found in three of the sick researchers.

The problem with this scenario is that thousands of scientists around the world are working with similarly toxic or genetically altered substances. If the problem was in the lab, says one skeptic, why haven't cancer researchers everywhere been stricken with similar diseases? Until we get the results of Bernard's investigation, we won't be able to estimate the risks lab workers face.

"Researchers in virology and bacteriology are using techniques that haven't been studied," says Annie Sasco, an IARC epidemiologist. "If they present a risk, only now will we start seeing it."

Another potential hazard of the researchers' work was the manipulation of oncogenes through recombinant DNA. Kelly ran a study in which mouse embryos were injected with oncogenes to observe the progress of cancer. An escaped oncogene, however, is an extremely unlikely culprit. Geoffrey Cooper, a Harvard Medical School professor acknowledged as one of the pioneering researchers in the study of oncogenes, says that research strains are specifically designed so that they couldn't multiply if one *did* manage to infiltrate a scientist's body.

There may never be a simple explanation for the Pasteur cluster. According to Robert McKinney, director of the safety division at the National Institutes of Health, only 18 percent of occupationally acquired infections have ever been attributed to a known event or accident. "We all have oncogenes at birth," he says. He believes that exposure to certain chemicals could trigger a latent tendency toward cancer into a full-blown disease.

Bernard has steadfastly refused to comment on assorted theories put forth by the press and by concerned scientists to explain the cancers. Although his commission is due to publish the results of its investigation next year, many scientists remain cynical as to the value of its painstaking detective work. Bernard Dutrillaux, a cancer researcher at the Curie Institute, another French research organization, questions the validity of establishing a connection between the researchers' work and their cancers. "How can you prove that a substance handled ten years ago is the cause of a cancer found today?" he asks. If Bernard has an answer, we'll know in 1989. ∞

IN A WORLD

CONTINUED FROM PAGE 151

Some search compulsively for connections. Some don't.

I think of Kip's messy life, his hysterical nights. He has sketched a woman in the scotch; she has long hair. Lara, I remember, has long hair, which she wears in a neat twist.

"Fuck it," he says suddenly, violently.

I say, "I don't believe any of this."

"You don't want to believe it. Too much of a comic book. Look at you—you're red in the face. *You!*"

I say stiffly, "Do you think you can get home all right?"

Kip throws back his head and laughs, a sound of such reckless amusement that I am shocked.

"Christ, John, you're priceless! Pissy to the end. Don't you see it, even now? *This is the end of this information system.* Any hour now—"

The bartender has been walking toward us, rag in hand and eyes disapprovingly on the mess Kip has made all over the bar. As we watch, the rag bursts into flames. The bartender yells and hurls it into the sink; the stainless steel begins to stain, then abruptly stops.

"Different information systems operating there." Kip says conversationally and laughs again. I hit him on the arm, hard.

"Stop it!"

He grins at me. "Why, John, you man of few words, I never knew you cared." His grin widens. "About anything." Then he says, in a different voice, "In living things, the very complex system divides. Like with sexual reproduction."

And for some reason this statement—no less abstract than the rest of his crazed theory—makes sense. The pond drains away, and I see the tire iron nearly clear, only it's not a tire iron but a dangerous club, covered now only by a passing wave, a watery shimmering—

A shimmering—

"Oh, my God."

"What now?" Kip says, still smiling.

A different state of information. Some types of mind search compulsively for order. Black and white, with no gray.

"You damn fool!" I shout. "All of you damn fools!" Kip rises from the bar stool, combative or concerned. I don't care which. I am running out of the Depot, hitting the doorjamb with my shoulder as I hurl through.

The doorjamb responds by turning from brown to yellow.

All the four blocks home it is like that. Things happen as in dreams. Trees turn purple, shade through indigo to blue, return to green as information about the wavelength of light alters its coding. The sky is red. A parked car serenely floats two feet straight up, then drops. The air fills with staticky noise, weird, chaotic droning that turns briefly into the theme from Handel's Suite Number Five. It is hot and then freezing. I reach the street end of my driveway, which has begun to melt. One moment I am running, and the next I feel my legs and arms and heart pump as hard as ever, but I do not move. I am suspended. Time itself does not move; hangs suspended.

The complexity barrier. This is the decisive passage, the crossing point.

I am too late.

I am xjj sbeg.

vyp "c#1 4mm p—

Then the moment passes, and I am standing dazed in the middle of the new information state.

The trees stand straight. The sky is blue. Parked cars are parked, the McMillans' BMW has a ticket stuck under the wiper. A quiet breeze blows. At my feet the green grass thrusts upward through cracks in the asphalt in its eternal bid to extend roots, reproduce itself, control my driveway. At the end of the driveway stand two houses.

One is the familiar center-door Colonial I left this morning in hurried disorder, socks on the bathroom floor, an unanswered letter from my sister on the coffee table, no silver candlesticks because they have been burglarized, newspapers filled with airline disasters and stock market gains, multiple lottery winners and simultaneous earthquakes, random muggings and paragraphs of garbled gibbersh. The letter from my sister was one I wasn't going to answer. I never particularly liked my sister.

The other house is a bluish shimmer. Colonial lines still in the process of fading in and out. Right now it is hard to see clearly, like a house under deep water. But I know perfectly well what will be inside. All the shopping lists will be written with explanatory clauses.

Desperately I glance down the length of street. Number 54 stands alone, old Mr. Ashrider's a widower. Number 56 is a double shimmer. Elizabeth Hauser stays home with her and Ed's small children. Number 58, double. Jane and Carl Romano recently reconciled. Number 60, not the Griswolds are off vacationing in Jamaica. Number 62, double. Chuck Dugan has remarried.

Anger seeps through me, but there is no time for anger. Already the blue shimmer of my second house is fading. I can't remember—did Kip say that information states, like galaxies, all move farther away from each other?

Shopping lists, independent clauses. Burglars and infidelities, with life histories. Answered letters. Sex talk that means exactly what it says, no more and no less. A low-possibility state, with few shades of gray. Everything personal, connected.

And Emily.

I stand rooted to the asphalt, uncertain. But there is no longer room for uncertainty. Still, even as my feet carry me forward, I do not know which of the two houses I will enter. ◻◻

EXPLORATIONS

CONTINUED FROM PAGE 26

excavating fish fossils on federal land in Wyoming's Green River formation, the bottom of a prehistoric sea. It's the first time such a case has gone before a grand jury. And the harvesters were caught only after they had dug a trench a mile and a half long and ten feet deep. "We're finding that illegal harvesting is more common than we had previously believed," says BLM agent Bill Vernon, who collected evidence for prosecutors in the Green River case.

Because the problem is so widespread, Wyoming's state geologist Gary Glass opposes commercial quarries on federal land. "There's just no way of knowing where fossils come from," he says. "As long as private quarries are operating, dealers will claim their fossils come from private quarries."

Larson, however, believes outlawing all fossil harvesting will have only negative effects. "It certainly would put the good people out of the business, but the bad people would remain," he says. For instance, he points out, efforts by amateurs and commercial harvesters have long benefited museums. In the early twentieth century, Charles Sternberg and his sons collected numerous fossils on commission for museums. And eccentric millionaire Childs Frick assembled one of the world's greatest collections of mammalian fossils, which he eventually donated to the American Museum of Natural History.

Larson and other fossil dealers and hobbyists have banded together to lobby the BLM, as well as congressmen, to legalize harvesting on federal lands. A National Academy of Sciences (NAS) committee studied the government's regulations concerning fossil collecting. The committee has recommended legalization of commercial digging in national forests and on BLM land. "Barring any public outcry," says Carl Barna, head of the BLM's paleontology program, new BLM regulations allowing commercial digging will probably be the result.

Some vertebrate paleontologists are irate over the NAS recommendation and decry the composition of the committee. "Some people on the committee had no business being there," says one vertebrate paleontologist. "It was like the fox watching the chickens." Indeed, committee members included four fossil dealers and nine paleontologists, only four of them were *vertebrate* paleontologists, the ones who study bones.

For museums, fossil harvesters are a mixed blessing. "They often get in and smash things up," Horton says. "They're collecting specimens to make tie tacks out of them, for God's sake. But others give fossils to museums and keep popular interest high. And you've got to cater to people's enthusiasm for fossils." ◻◻

SIX FLIGHTS

CONTINUED FROM PAGE 104

Washington Bridge. It was possible to believe that the city did not exist, that it was just the two of them, the suspension bridge itself only a suggestion against the night that held them.

"It's going to make a pretty blaze," Frank said.

He pitched the directional signal upward indolently, cut to the right lane of the upper roadway to take the parkway exit. "Chicago was nothing to the way this will be. This still is the *big town*." His smile, she knew would split the night if she looked, but she was facing away, staring through the passenger window, looking at the poles as the car skirted them. "'We shall utterly consume all things off the face of the earth.'" Frank said happily, "and that's the prophet Zephaniah. Always liked Zephaniah. They thought he was a crank, you know. Now he's a minor Book."

Constanza shuddered, drew the shawl around her. The heater was on, the car a furnace gathering fumes from the engine core and expelling them through the flaps near her legs, but she was cold in a way heat could not reach, cold in a way that was not to be touched. As cold as any city in the ashes of their long fire. Frank was giggling now, singing a little against the band noises that came from the radio, mumbling about fires and pyres and sires turning the dire night breaths and deaths and quests from the city, and it occurred to Constanza, possibly for the first time, that this was the principal difference between Frank and herself. He loved his work. She was the more competent, possibly even the one who had better reasons, but Frank was owed in the implication in the fire, in every lush and splendid exercise of conflagration. He would sing all through it, even if the devastation were to claim him, he would go smiling, as long as he were the focus of the could take the credit. But for Constanza it would be different, pieces of her would be extinguished, and she could *not* keep from feeling a trace of pity. "Do you ever think about it?" she said.

He looked up from the wheel, the car wavering on the descent.

"Think about what?"

"Watch your driving. Concentrate on the road."

He shut off the radio. "What are you talking about?"

"Don't have an accident. Not with what we're carrying."

His eyes were wide and bewildered. "I don't understand," he said. "You talked to me. I didn't say a word. I'm watching the road, you're the one who's talking—"

"Oh, all right," she said, "you're right, you're right, just watch the road, don't get us into trouble, don't put us into a grider, we'll blow up everything north of Harlem and we'll never be able to get out of it alive. They'll never understand—"

Frank sighed, a deep, confused sigh, and Constanza faded, drew further into herself on the seat. He was right, of course, she was the one who was acting in a silly and misdirected fashion. The one who was falling apart. Frank was doing fine, in control, the car gliding neatly into the merge lane and then at a steady and controlled burst was taking the center on the sparsely midnight roadway, moving up to sixty. Local streets would be easier, less exposure there. At the end, assuming they got to the water, ignition and upheaval would be routine. Frank was right; she should shut up. The cold clawed at her suddenly. "I'm cold," she said. "Give us some heat!"

Frank reached out, moved a switch. "Don't be afraid," he said. "There's nothing to be afraid of."

"I'm not afraid."

"San Francisco went okay, didn't it? We

> *"The heater was on, the car a furnace gathering fumes from the engine core and expelling them through the flaps near her legs, but she was cold in a way heat could not reach."*

thought we were goners on the Golden Gate when the cops picked us up, but it was just a routine check and we were free. Chicago was beautiful, nobody thought it would go that easy. We're doing fine, Countess, it'll work just as well here."

"It's too big. It's New York, it's—"

"It's just another place," Frank said. "They're all the same, it's just a matter of numbers. Abilene, Corpus Christi, Schroon Lake, the training camps, those were just a body count. Chicago and San Francisco were the same, only bigger. All of them are the same: sinners in heat, snakes in darkness, the Devil's legions. There are just *more* of them here."

"It all happens so fast." She was talking wildly. She knew it. They had warned her of this, too, the possibility of panicky upheaval, her tendency toward hysteria. That was why they had teamed her with Frank. Frank was a steady guy, his eye was on the sparrow, he was a solid citizen, steady with his hands and with the fuses. "Chicago went in ten seconds. It was there. Boom! It wasn't there. It took so little—"

"And the same here. Set the fuses, wire the incendiaries, go, go, go! It's all the fire, Countess."

"That's not what I meant," she said. They were coming up on the Ninety-sixth Street exit, only a couple of miles to go now. No traffic at all in the density and the damp, it was as if on this midnight the roadway had been laid out for them. Maybe it had. Frank's hands were steady, his eyes were fixed on some tunnel of perception, his white sleeves billowed in the heavy gusts from the heater. The Dodge hit a bump, and she heard the thing clang from the trunk, the equipment rolling loose, reminding them. "So many people," she said. "Seven million."

"*Ten* million," Frank said with satisfaction. "Ten million sinners. Ten million heathens, celebrants of the darkness, ten million who have known corruption and are unacquainted with grief. But we'll change that. We'll change that—"

"It's too much. What are we doing?"

"Don't forget the little towns, too," Frank said, "or that trial run at Schroon Lake. Oh, boy, we've come a long way."

"No," Constanza said. The word seemed to have been dragged from some reservoir of unconsciousness, spoken out of herself. "No. I can't go through with this. We have to stop. This isn't San Francisco or Chicago."

"It's the biggest town of all, Countess. That's why."

"Frank," she said, "let's give it up. Get off at Ninety-sixth Street and turn it around. We'll go back. Tell them it's all my fault. *I'll* tell them. Get someone else. I'll take all the blame. I must—"

"Calm down. You're going to be all right. You've been fine until now. It's no big deal—" She put her hand on his wrist. Warm but unyielding, steel under the sleeve, the white on white. "There's a parking area at Ninety-sixth Street," she said, "remember?"

"I remember everything."

"Pull it in there. Pull it in there, and stop the engine. I'll give you everything. I'll give you what you want. Frank, if you'll just bring it to a stop."

His hand twitched. "You're a sinner, too. You're asking me to sin. You're offering me your flesh for their flesh." His voice cracked on the second *flesh*. "I can't. I won't."

"Don't you want to? Don't you want to touch me, really touch me? You know you do. The lies they tell, the things they gave us to do, that's just to keep you from knowing what you really want, what you really need—"

He was jumping and quivering under her touch, the car swaying, but the car was slowing too, as they came up on the Ninety-sixth Street sign, and she could tell, yes, she could tell. She had him now. She had him. "Forget the fuses," she said, "forget the bombs, forget the bodies, just this once, just think of me, of what you're going to do soon—"

"What will we tell them?"

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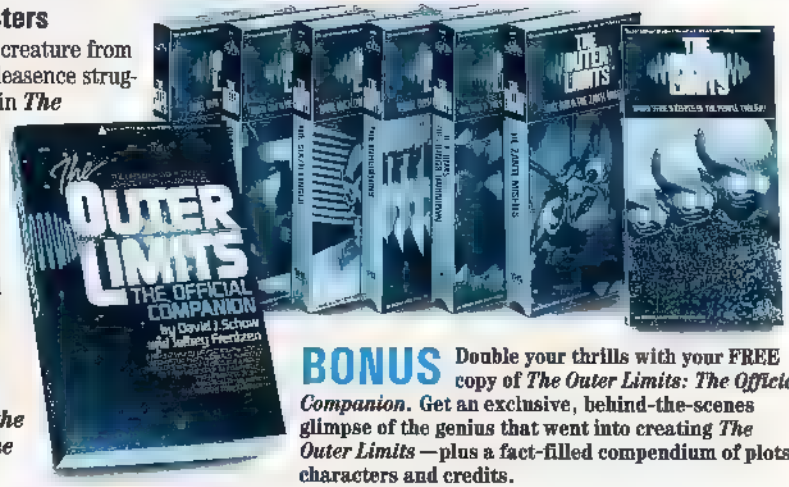

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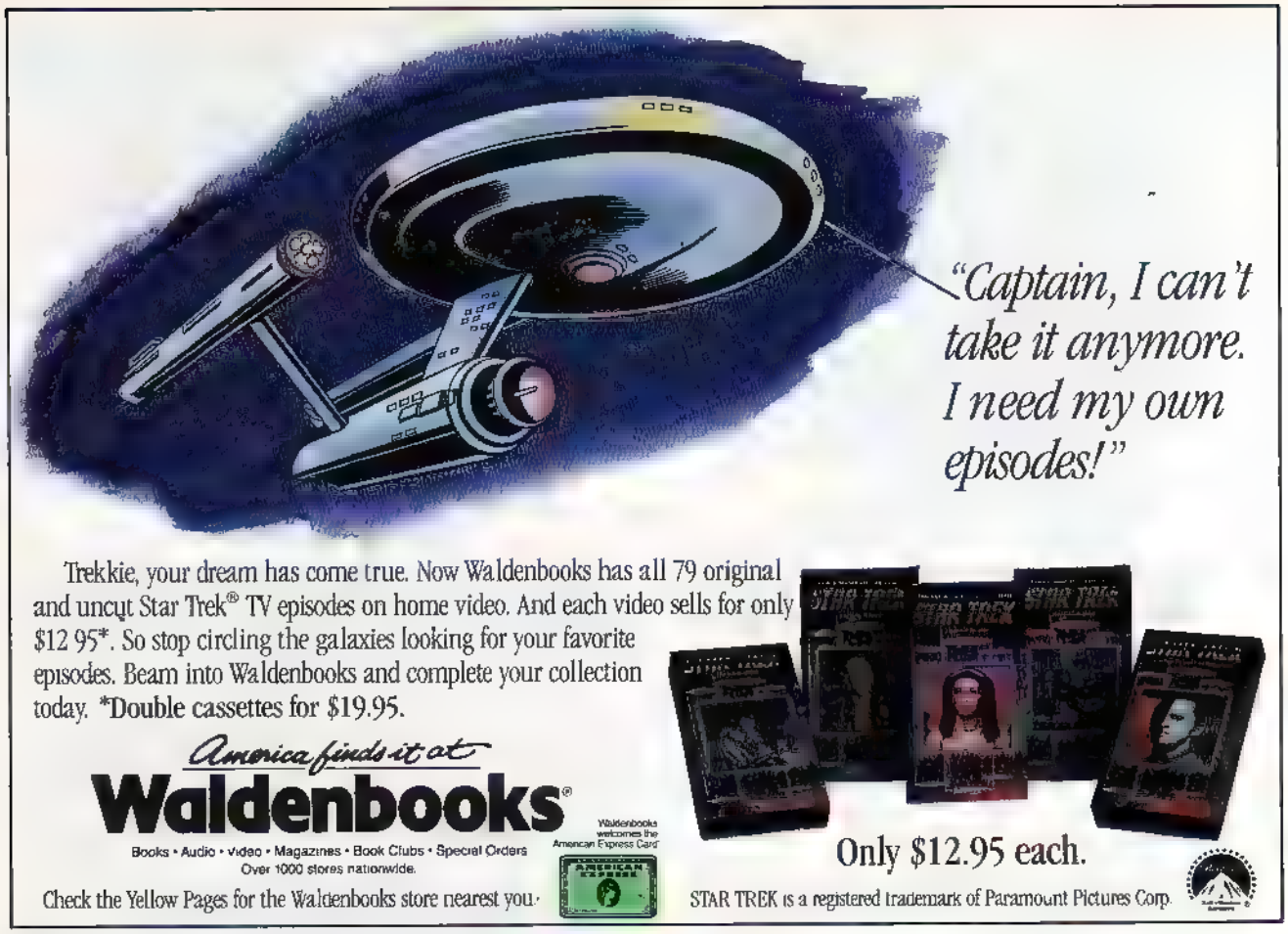

"We don't have to tell them anything," she said with a shocking sense of discovery. "We can stay. We can just live here, like the rest of the sinners. Find our way. Trade weapons for food. We'll be free. no one will find us, they won't *want* to find us, the committee, they'll just get replacements. But that will take time, the training takes a *long* time, and in the meanwhile—"

Trembling, trembling everywhere, Frank guided the Dodge into the rest area, the brakes quivering, the frame shaking, the incendiaries bouncing. 'Meanwhile, we'll be sinners. We'll join them in the nakedness of their captivity."

She reached out with her free left hand, stroked his inner thigh. "Yes, the nakedness of their captivity." The car pitched. Frank braked, foliage grabbed them, they were against the trees. The car bumped, sagged. The engine rumbled. Constanza reached out, cut the ignition, reached to clasp his cheeks and draw him upon her.

His tongue was moist, desperate. "But why?" he whispered, as the engine *ticced!* to silence, as she came over him, fury as the sounds and the force of her own desperation overtook.

"Why are you doing this for the sinners? What do you care?"

'Because," she said, placing his left hand on her breast, "because they cannot discern their right hand from their left, the sinners," showing him what she could do with her right hand and her left. "Nor can their cattle."

"Book of Jonah," Frank said, heaving on her. 'Final verse.'

"*Also* much cattle.' she corrected herself.

They were well beyond words, well beyond thought when, furious but paralyzed by shock, the archangels so came upon them.

THE NEW FLOOR

By K. W. Jeter

Jim watched as the attorney lowered the stapler out the window. All over the city, at any time of day, staplers or scissors or ashtrays, all sorts of small weights—were being lowered out of office windows. They slid down the gray walls of the buildings, past the mirror glass shining like jewelry, they tapped at the sidewalks below. And were hauled back up.

Mackelson reeled in the stapler. "There—you see?"

He held the string out like a fisherman bragging of his catch. There were black pen marks along its length. "That's nearly—must be *twice* as fast. Compared to last week."

He listened to Mackelson and looked at the string but didn't give a fuck. The attorneys could eat their stomachs out over the building's sinking. It didn't matter to him.

"It'll be pretty soon now." Mackelson brooded over the black marks. "We'll have to be ready."

The street traffic murmured. In this building, the windows opened. In the newer high rises, with everything sealed, the tenants broke out the corners of their windows so they could do their string-and-stapler thing. It drove the building engineers nuts, but there wasn't any point in replacing the windows, they would just do it again.

'Ready." Mackelson gazed upward.

Jim held back a yawn. Weren't the attorneys ready, all of them, all the time? With their strings and measuring and calculating and scheming—ready and waiting. Yet they were always the last to know. Jim and the other clerks all had lunch outside, on the benches beside the statues covered with pigeon shit.

They could watch the cranes on top of the buildings, hoisting up girders and stuff. Then the wall panels—they'd know the new floor was just about finished.

'That's why I want you to do something special for me." Mackelson dropped the stapler inside his desk drawer. "For me and for Wilson. And it's gotta be done ASAP. All right?"

Jim nodded and listened.

"All the way down there? What for?" Peter looked at the slip of paper. "The elevators don't go down that far anymore."

Jim took back the slip with the five numbers. "Some case that's being reopened—don't ask me. They just want the files brought up. Okay?"

"Yeah, but... the elevators..."

Peter bitched all the way down. When the elevator ground to a halt, Jim had to pry the doors open. Peter watched him like a lump. That pissed him off, so when they got out into the dark hallway, he rolled the dolly toward the stairs without looking back. Peter scurried to keep up, afraid of being left behind.

"You feel as though looking for someone?"

Jim had lost count of what floor they'd gotten down to, bumping the dolly along behind him, and had gone out to the elevator lobby to check. His flashlight had caught an old man shuffling around. The man smelled like dust.

"I thought maybe... you were the interoffice delivery." The old man fumbled with his tie, working the knot of loose gray strings. His suit had a stain from the crotch up to his vest. "I hadn't seen the fella with the cart for... for a while now."

Jim wondered how long the old man had been down here. Maybe the man hadn't been old when he'd realized that the firm wouldn't be moving him to an office on the floor above his old one every time a new floor was finished at the top of the building. He'd probably had time to get used to the idea, maybe years of the stapler taking less and less string to reach the sidewalk until he'd been right there at ground level, looking out at the fast-striding pedestrians, all of them turning their faces away, filled with embarrassment and dread. Or maybe the old guy had gotten a sudden shock, a drop from the light slanting through the steel canyon, into the dark. There were stories about one building hitting an air pocket below the deepest subbasement and dropping ten, twelve feet at once. The clerks told the story to each other, going haw-haw at the imagined panic among the attorneys and executives up through all the floors. It could've happened, Jim figured. The financial district was built on landfill, real estate created out of nothing, where the ocean or the river or the lakefront had been. He wasn't sure which riding home after work, he'd gaze at the dark slurry beyond the window and could almost see, past the reflection of the other riders' faces, the fish making slow progress through the water and gravel.

The story's capper—there had supposedly been a bum nestled up against the side of the building, sheltered in the angle of wall and sidewalk, when it had popped downward. And the bum's dirty overcoat had been dragged along by the sinking building, pulling the bum down with it, until just his legs and arms could be seen sticking up out of the crack at the edge of the wall.

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The janitors had cleaned up the mess, plucking away the limbs the way you'd prune a tree. Which meant that if it were true somewhere on the side of one of the buildings, maybe even against one of the dark windows, the bum was still there, scraped flat. With his grizzled face against the glass, his stumps spread-eagled, the HOMELESS AND HUNGRY sign around his neck a little now.

"We're just picking up some files."

The old man shuffled away. He opened a door, and Jim saw a rolling flash of blue light. A copy machine still working—he hadn't known that they still kept any electricity running this far down. The old man hunkered in the circle of figures around the machine, a nest of memos and tattered manila folders. A hand reached up to the PRINT button, and another pulse of light washed against them.

When they got to the basement storeroom, Peter griped about all the file boxes. "Just take whatever you can handle." Jim eased the weight back on the dolly. "Then you can come back down for the rest." As he wheeled the dolly around, he could hear Peter muttering and humping the rest of the load.

They were stacking the files in Willson's office; the boxes smelled of damp and rot, the cardboard spotted with mold—when Willson and one of the senior partners came in.

"What's all this?" The senior partner pointed to the boxes.

Mackelson was behind him, in the doorway. "That's that FPC thing that we have to clink around with again. It got booted up from appellate. So I had 'em haul everything back up."

Jim straightened up. He'd seen Willson's face go gray after his eyes had widened in surprise.

The senior partner turned toward the door. "Well, there's no point in moving all this stuff twice. Let me know when you get an idea of what your schedule on this is going to be."

Willson's eyes had gone red, the wet trembling at his lashes.

Outside Willson's office, Jim saw Mackelson talking to one of the younger attorneys, a kid with an office a couple of floors down. Jim had seen him lurking around on this floor all day.

The young attorney turned his head and smiled at Jim.

Mackelson was standing at his new window when Jim came in. Without knocking. He dug a couple of twenties from his wallet and held them out to Jim. The desk top was cluttered with the junk from his old office: the pictures for the walls, the Cross pen set. He'd have to sort all that out, settle in.

"Hey, thanks for getting right on to that little job." He twitched the bills in his hand. "I appreciate it."

Jim didn't take the money. "You really

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stuck it to old Wilson. Didn't you?"

Mackelson shrugged. "Wilson's not as sharp as he used to be. You don't want to stay hooked up with somebody like that. You want somebody that if you do him a favor, you're gonna get something good back. Like that Bennetti kid. He's a real up and comer."

"I thought you and Wilson were friends."

"Well." He looked over his shoulder at the window. "What can I say?"

When it was dark, he was still standing at the window watching the lights. That prick file clerk was going to be a problem. The problem was that Jim didn't want anything, there was no way of getting at him. He'd have to work on the others. Line up somebody else. There were always jobs that had to be done.

He heard somebody moving around, up above, through the acoustic tiles and the light panels, the sound of footsteps, pacing back and forth.

The bastard was nervous, whoever it was. Mackelson tilted his head back. Listening. The guy was scared. He smiled. That meant the guy could be had.

He felt tired, he sat down and laid his head on the desk. He closed his eyes, but the business with Jim still bugged him. Jim must've gotten bent out of shape because of seeing the people down there on the lightless floors. Imagining old Wilson with them, shuffling around.

Those people had it easy, anyway. What was the fuss about? All over the world, in Tokyo and New York and Los Angeles, buildings were sinking, like needles into an orange. They would meet at the center, in the dark warmth of the earth's core. Willson and the rest of them would melt and fuse together, each with the other. They'd never any of them, be alone again.

But up on the roofs of the buildings, in among the cranes and the raw girders of the unending construction—the most senior attorneys, the grand execs, the chairmen of all the boards—they'd be up in there in splendor and isolation, their faces creased to leather by the wind, the cold rain dripping from their chins. Gazing as eagles do, toward the sun, always staying just out of their reach.

The attorney slept and dreamed, the streets' tide curled around the building.

HOOVER'S MEN

By Howard Waldrop

On March 30, 1929, three weeks after A. Smith's presidential inauguration, four gunmetal-gray Fords were parked on a New Jersey road. On the tonneau top of each was a large silver loop antenna.

There were fifteen men in all, some inside the cars in their shirtsleeves, earphones on their heads, the others sitting on the running boards or standing in stylish poses. All those outside wore dark blue or gray suits, hats and dark ties with small checks on them. Each had a bulge under one of his armpits.

It was dusk. On the horizon two giant aerials stood two hundred feet high, with a long wire connecting them. They were in silhouette, and here and there they blotted out one of the early stars. Back to the east lay the arglow of Greater Manhattan. Men in the cars switched on their work lights. Outside the first car Carmody uncrossed his arms, opened his pocket watch, noted the time on his clipboard. "Six fifty-two. Start your logs," he said. Word passed down the line.

He reached in through the window, picked up the extra set of headphones next to Dalmas, and listened in.

"This is station MAPA coming to you from Greater New Jersey with fifty thousand mighty watts of power. Now to continue with *The Darkies' Hour* for all our listeners over in Harlem is Oran 'Hot Lips' Page with his rendition of 'Blooey!' featuring Floyd Horsecollar Williams on the alto saxophone."

"Jesus," said Dalmas, looking at his dials, "the station's all over the band, blocking out everything from seven fifty to twelve forty-five. Nothin' else is getting through nowhere this side of Virginia!"

Carmody made a note on his clipboard pages.

"The engineer—that's Max—said sorry we were off the air this afternoon for a few minutes, but we blew out one of our heptodes and you know how danged particular they can be. She says we'll get the kinks out of our new transmitter real soon.

"Don't forget—at 7:05 tonight Madame Sosostris will be in to give the horoscopes and read the cards for all you listeners who've written her, enclosing your twenty-five cent handling fee, in the past week."

Start up the wire recorders, said Carmody.

"Remember to turn off your radio sets for five minutes just before seven PM. That's four minutes from now. First we're going up to what, Ma? two hundred ninety thousand watts—in our continuin' effort to contact the planet Mars, then we'll be down to about three quarters of a watt with our antenna as a receiver in our brand-new effort to make friends with the souls of the departed.

"Here to end our Negro music broadcast for this evening are Louis 'Satchmo' Armstrong and Dwight 'Ike' Eisenhower with their instrumental Do You Know What It Means to Miss New Orleans? Hang on this one will really heat up your ballast tubes."

Some of the sweetest horn and clarinet music Dalmas had ever heard came out of the earphones. He swayed in time to the music. Carmody looked at him. "Jeez. You don't have to enjoy this stuff so much.

We have a job to do" He checked his pocket watch again.

He turned to Mallory. "I want precise readings on everything. I want recordings from all four machines. Mr. Hoover doesn't want a judge throwing anything out on a technicality like with the KXR2Y thing. Understood?"

"Yeah, boss," said Mallory from the third car.

"Let's go, then," said Carmody.

Just then the sky lit up blue and green in a crackling halo that flickered back and forth between the aerials on the horizon.

"Yikes!" yelled Damas, throwing the earphones off. The sound coming out of them could be heard fifty feet away: "EARTH CALLING MARS! EARTH CALLING MARS! THIS IS STATION MAPA. MA AND PA CALLING MARS. HOWDY TO ALL OUR MARTIAN LISTENERS. COME AND SEE US. EARTH CALLING MARS. ..."

They burst through the locked station door. Small reception room, desk piled high with torn envelopes and stacks of quarters, a glass wall for viewing into the studio, locked power room to one side. A clock on the wall that said 7.07. There was a small speaker box and intercom on the viewer window.

An old woman was sitting at a table at a big star-webbed carbon mike with a shawl wrapped around her shoulders and a crystal ball in front of her. An old man stood nearby holding a sheaf of papers in his hand.

"... and a listener writes: Dear Madame Sosostris ..."

Carmody went to the intercom and pushed down the button. He held up his badge. "United States Government, Federal Radio Agency, Radio Police."

They both looked up.

"Cheese it, Pa. The Feds!" said the woman, throwing off her shawl. She ran to the racks of glowing and humming pentodes on the far wall, throwing her arms wide as if to hide them from sight.

"Go arrest some bootleggers, G-man!" yelled Pa.

"Not my jurisdiction. And Prohibition ends May first. You'd know that if you were fulfilling your responsibilities to keep the public informed," said Carmody.

"See, ladies and gentlemen in radio land," yelled Pa into the microphone, "this is what happens to private enterprise in a totalitarian state. The airwaves belong to *anybody*. My great uncle invented radio—he did!—Marconi stole it from him in a swindle. Government interference! Orville Wright doesn't have a pilot's license! He invented flying. My family invented radio."

"... you are further charged with violation of nineteen sections of the Radio Act of 1929," said Carmody, continuing to read from the warrant. "First charge, operating an unlicensed station broadcasting on the AM band, a public resource. Second, interfering with the broadcasts of licensed operations ..."

"See, Mr. and Mrs. Radio Listener, what putting one man in charge of broadcasting does! Ma! Crank it back up all the way!" Ma twisted some knobs.

The sky outside the radio station turned blue and green again. Carmody's hair stood up, pushing his hat off his head. His arms tingled.

"SOS!" yelled Pa. "SOS! Help! This is station MAPA. Get your guns! Meet us at the station! Show these fascists we won't put up with ..."

"We'll add sending a false distress call over the airwaves: incitement to riot and breach of the peace," said Carmody, penciling in his notes. "Having astrologers, clairvoyants and mediums in contravention of the Radio Act of 1929 ..."

The first of the axes went through the studio door.

"... use of the airwaves for a lottery." Carmody looked up. "Give yourselves up," he said. He watched while Ma and Pa ran around inside the control room, piling the meager furniture against the battered door. "Very well. Resisting arrest by duly authorized federal agents. Unlawful variation in broadcast power ..."

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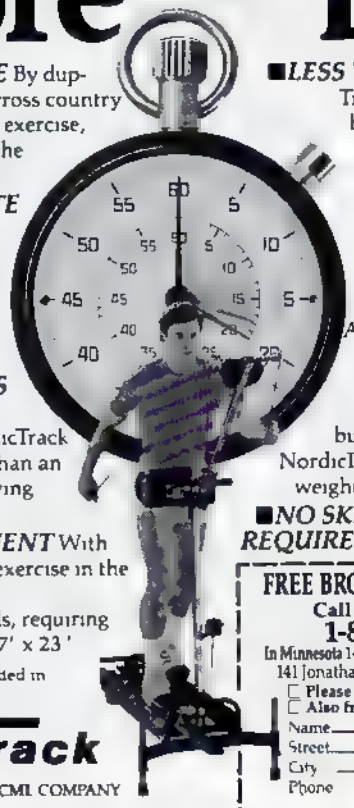

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"Squeak! Squeak! Help!" said Pa. Dalmas had bludgeoned his way into the shrieking power room and threw all the breaker switches.

Ma and Pa turned into frantic blurs as all the needles dropped to zero. The sky outside went New Jersey dark, and Carmody's hair lay back down.

"Good," he said, still reading into the intercom. 'Advertising prohibited articles and products over the public airwaves. Broadcast of obscene and suggestive material. Use of ..."

The door gave up.

"Book 'em, Dalmas," he said.

"Two minutes, Mr. Hoover," said the floor manager. He waved his arms. In a soundproof room an engineer put his foot on a generator motor and yanked on the starter cord. Then he adjusted some knobs and gave an okay signal with a circled thumb and finger.

Hoover sat down at the bank of microphones in front of him. A four- by eight-foot panel of photosensitive cells lowered into place in front of him. In a cutout portion in its center was a disc punched with holes. As the panel came down, the disc began to spin faster and faster. The studio lights came up to blinding intensity. Hoover blinked, shielded his eyes.

Carmody and Malory stood in the control room behind the engineers, the director, and the station manager. Before them on the bank of knobs and lights was a two- by three-inch flickering screen filled with lines in which Malory could barely make out Mr. Hoover. Carmody and the other chiefs had turned in their reports to Hoover an hour before.

"I never thought he'd take this job," said an engineer.

"Aw, Hoover's a public servant," said the director.

The STAND BY sign went off. Hoover arranged his papers.

ON THE AIR blazed in big red letters over the control booth. The announcer at his mikes at the side table said, 'Good evening, ladies and gentlemen. This is Station WRNY and its eleven PM in New York City. Tonight, live via coast to coast hookup on all radio networks, the Canadian Broadcasting System, and through the television facilities of WIXA2 New York and W2UA4 Washington DC, we present a broadcast from the head of the new Federal Radio Agency concerning the future of the airwaves. Ladies and gentlemen of the United States and Canada, Mr. Hoover.

The graying, curly-haired gentleman looked into the whirring Nipkow disc with the new Sanabria interlaced pattern and pushed one of the microphones a little farther from him.

"I come to you tonight as the new head of the Federal Radio Agency. After the recent elections, in which I lost the presidency to Mr. Alfred Smith, I assumed that after eight years as your secretary of commerce under the last two administrations I would be asked to leave government service.

"Imagine my delight and surprise when Mr. Smith asked me to stay on, but in the new position of head of the Federal Radio Agency. If I may quote the President, 'Who knows more about *raddio* than you do, Herbert? It's all in a *turrible* mess, and I'd like you to straighten it out, once and for all.'

'Well, tonight, I'm taking your President's words to heart. As chief enforcement officer under the new and valuable Radio Act of 1929, I'm announcing the following. Today my agents closed down fourteen radio stations. Nine were violating the total letter of the law; five were, after repeated warnings, still violating its spirit. Tomorrow, six more will be closed down. This will end the most flagrant of our current airwave problems.

As to the future —Hoover pushed back a gray wisp of hair that had fallen over his forehead— 'tomorrow I will begin meetings with representatives of the Republic of Mexico and see what can be done about establishing frequencies for their use. They were summarily ignored when Canada and the United States divided the airwaves in 1924.

The station manager leaned forward intently.

"If this means another division and realignment of the frequencies of existing stations, so be it," said Hoover.

The station manager slapped his hand against his forehead and shook his head from side to side.

'Furthermore,' said Hoover, 'under powers given to me, I am ready to issue commercial radiovision/radio movie/television licenses to any applicant who will conform to the seventy-line, thirty-frame format for monochrome ..."

'He's gone meshuga!" said the engineer. "*Nobody* uses that format!"

"Quiet," said Carmody. "Mr. Hoover's talking."

"... or the one hundred-forty-line, sixty-frame format for color transmission and reception, with the visual portion on the shortwaves and the audio portion on the newly opened frequency-modulated bandwidths."

'Aaiii!" yelled the station manager, running out of the booth toward the desk phone in the next office.

'He's *crazy*. Everybody's got a different system," said the director.

'No doubt Mr. Hoover's in for some heat," said Malory.

"To those who say radio-television is too primitive and experimental to allow regular commercial broadcasting, I say, *you're* the ones holding up progress. The time for review is *after* new and better methods are developed, not before. This or that rival concern have been for years trying to persuade the government to

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adopt *their* particular formats and methods." He looked into the whirling lights, put down his papers. "I will say to the people of those concerns: Here is your format, like it or lump it."

Then he smiled. "For a wholesome and progressive future in America, dedicated to better broadcasting for the public good: this is the head of your nation's Federal Radio Agency, Herbert Hoover saying goodnight. Goodnight."

The STAND BY sign came back on. The blinding light went down, and the disc slowed and stopped, then the whole assembly was pulled back into the ceiling.

In the outer office the station manager was crying.

Mr. Hoover was still shaking hands when Carmody and Mallory left.

Early tomorrow they had to take off for upstate New York. There was a radio station there with an experimental-only license that was doing regular commercial broadcasts. It would be a quiet shutdown, not at all like this evening's.

As they walked to the radio car, two cabs and a limo swerved up to the curbing, missing them and each other by inches. Doors swung open. David Sarnoff jumped out of the NBC Studebaker limo. He was in evening clothes. The head of CBS was white as a sheet as he piled out of the cab, throwing money behind him. One of the vice presidents of the Mutual System got to the door before they did. There was almost a fistfight.

There was a sound in the air like that of a small fan on a nice spring day. Overhead the airship *Ticonderoga* was getting a late start on its three-day journey to Los Angeles.

Mallory pulled away from the curb, heading back to the hotel where Dalmas and the other agents were already asleep. He reached forward to the dashboard, twisted a knob. A glowing yellow light came on.

"Geez, I'm beat," said Carmody. "See if you can't get something decent on that thing, okay?"

Nine years later, after his second heart attack and retirement, Carmody was in his apartment. He was watching his favorite program, *The Clark Gable–Carole Lombard Show*, on his brand-new Philco console color television set with the big nine- by twelve-inch screen.

He punched open the top of a Rheingold with a church key, foam running over onto his favorite chair.

"Damn!" he said, holding the beer up and sucking away the froth. He leaned back. He now weighed two hundred seventy pounds.

Gable was unshaven, he'd apologized at the show's opening; he'd come over from the set where they were filming Margaret Mitchell's *Mules in Horse's Harnesses* to do the live show. They'd just started a sketch with Lombard carrying a bunch of boxes marked ANACONDA HAT COMPANY, asking Gable for directions to some street.

Then the screen went blank. "Shit!" said Carmody, draining his beer.

"Ladies and gentlemen," said an announcer, "we interrupt our regularly scheduled program to bring you a news bulletin via transatlantic cable. Please stand by."

A card with the message NEWS BULLETIN ONE MOMENT PLEASE came up on-screen. Then there was a hum, and a voice said "Okay!"

A face came on-screen, a reporter in a trench coat stepped back from the camera holding a big mike in one hand.

"This morning, three A.M. Berlin time, the prime minister of Great Britain and the chancellor of Germany seemed to have reached an accord on the present crisis involving Germany's demands in Austria. Past his shoulder there was movement, flashbulbs went off like lightning. "Here they come," said the newsman, turning. The camera followed him, picking up other television crews with their big new RCA/UFA all-electronic cameras the size of doghouses trundling in for the same shot.

On-screen SA and SS men in their shiny coats and uniforms pushed the reporters back and took up positions, machine guns at the ready, around the chancellery steps.

Atop the steps the prime minister and the führer, followed by generals, aides, and diplomats of both countries, stepped up to a massed bank of microphones.

"Tonight," said the prime minister of Great Britain, "I have been reassured, again and again, by the chancellor that the document we have signed"—he held up a white piece of paper for the cameras, and more flashbulbs went off, causing him to blink—"will be the last territorial demand of the German nation. This paper assures us of peace in our time."

Applause broke out from the massed NSDAP crowds with their banners, standards and pikes. The camera slowly focused into a closeup view, while the crowd chanted *Sieg heil! Sieg heil!*—of Herr Hitler's beaming face.

"Bastard," yelled Carmody and sent the empty beer can ricocheting off the console cabinet.

A few minutes later, after the network assured viewers it would cover live any further late-breaking news from Berlin, they went back to the show.

There were lots of wrecked hats on the street set, and Gable was jumping up and down on one.

Lombard broke up about something, turned away from him, laughing. Then she turned back, eyes bright, back in character.

"Geez, that Gable," said Carmody. "What a lucky bastard!" ∞

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ARTICLE

It's interactive enough to seem almost alive. The 'vore can wander around the room and run away from objects in its path

THE OMNI PHOTOVORE

HOW TO BUILD A ROBOT THAT THINKS LIKE A ROACH

BY JONATHAN CONNELL

When asked by *Omni* to design a robot insect appropriate for its readers to build I couldn't help reflecting on the history of artificial intelligence (AI) itself. For years my colleagues in AI have tried to understand how human beings think. Early efforts were aimed at highly cerebral tasks such as playing chess and solving algebra problems. These projects met with unqualified success and showed that computers could easily perform tasks that were difficult for people.

Unfortunately scientists soon found that the converse was also true. Computers just could not do the things we all find incredibly simple, things like tying our shoes or walking around without bumping into things. To correct this deficiency, researchers turned their attention to the fields of vision and robotics. As a result, we now have dexterous robots that fabricate many of the high-tech products we take for granted, from airplane engines to automobile parts. We also have automatic inspection systems to ensure the high quality of these goods.

Yet there are still major bastions of machine incompetence. Everyone has seen R2-D2 and C-3PO, the slapstick team of Laurel and Hardy-like robots from *Star Wars*, the cute Number Five in *Short Circuit*, and the immensely powerful galactic superheroes on Saturday morning television. But in the real world of today, C-3PO would fall on his face even before taking his first step, and R2-D2 would bumble aimlessly through Princess Leia's starship. Indeed the sad truth is that those of us on the forefront of AI research lack even a vague idea of how to make such sophisticated devices. While we would love to create the sort of robots portrayed on TV and film, the technical challenges seem insurmountable at present.

In the MIT mobile robotics group our approach has been to start with simpler creatures and work our way up the evolutionary ladder. Toward this end, we have chosen insect-level intelligence as a worthy initial goal. The insect nervous system is simple enough so that it's roughly on a par with modern computers. Furthermore, insects engage in a limited number of well-defined activities. While no one would call an ant smart, it does an admirable job of surviving in a highly unstructured, dynamic environment. To those of us in the AI lab at MIT, imbuing a robot with similar capabilities is a significant first step toward true intelligence.

So what features characterize the insect brain? Bugs are not known for being great conversationalists, nor do they engage in abstract activities such as planning for the future. In philosophical terms, a cockroach has no conception of self. Its mind is a schizophrenic collection of impulses that compete for control of the body. Another way of saying all this is that bugs are driven by instinct. That is, a certain type of situation will always elicit a certain type of response. No reasoning is involved. These responses, or reflexes, are hardwired into the creature's brain from birth.

At the AI lab, those of us building mobile robots have tried to instill the basic features of the insect brain in our own creations as well. Our robots have what we call insect intelligence: a set of separate "instinctual" behaviors that cause them to react to specific situations and specific environments in specific ways. By turning on successively higher levels of behavior, we improve the performance of a robot at its given task.

Whenever we build a robot, we create the most basic parts first. To interact with the world, first of all, our robot needs a body—a scaffold, or skeleton, from which its organs (i.e., a computer brain and engine) and sensors can hang. We find that the easiest way to construct a robot body is to use the chassis of a remote-controlled toy car. Such cars, of course, are normally controlled through radio signals sent by the user. But since the robots must be autonomous, we rip out the original radio units and replace them with electronics of our own. The electronic drive enables the robot to move forward and backward or turn to the left or right.

This by itself is not very interesting. The robot still needs a way to perceive the world. Our first true insect robot accomplished this with four infrared proximity sensors. These devices emit a modulated beam of infrared light, the same kind of light used by TV remote controls and Lazer Tag guns. To find obstacles (which the robot can then avoid), the sensors seek out any reflection brighter than a certain threshold. The sensors note the presence of the object and communicate the information to the robot brain. The brain, which we generally build with sev-

eral layers of complexity then uses this information in a number of ways

For instance since an insects first priority is to stay alive the first brain layer is dedicated to survival Our robots relatively fragile and may break if it collides too energetically with walls or furniture—or for that matter if someone steps on it (the fate of many bugs) One good way to avoid these situations is to run away from anything that invades your personal space Our robots conception of space is defined by its sensors if any one of the four sensors located in front in back and on either side detects an object the robot is potentially in danger To extricate itself the robot needs to move But where?

In nature many creatures do not take the time to really decide Instead they simply move in whatever direction they are facing When startled for instance dragonflies always take off forward and then go up at a 45 angle Although this seems to be a naive response it usually works quite well

Our artificial insects take a more sophisticated escape route one we have engineered thanks in part to elementary physics If you think back to high-school or college physics you remember that like charges (for instance two positively charged spheres) repel one another and that the force between them decreases as the distance increases (As the textbooks say the force is inversely proportional to the square of the distance)

Now imagine that our robot is a positively charged proton and that the obstacles it senses are also protons In this situation our robot would feel a repulsive force causing it to move directly away from the other protons Our robot computes the relative distance of each obstacle then combines the individual contributions to figure out in which particular direction to move This behavior which we call "runaway" is a good collision avoidance formula because it pays more attention to nearby obstacles than to distant ones It is even smarter than many insects because it can cope with multiple threats at the same time

This technique moreover is particularly valuable in robotics because it allows us to add as many extra sensors as we might want For example we might add extra sensors to the top of the robot so it would know when it was about to be stepped on We can wire extra sensors into the existing system and then reprogram the robot so that the additional information is factored into the equation that tells the robot where to move

The creature described up to this point is largely sessile Like a hibernating bear it will move when prodded But if left alone it will remain still

In the real world of course animals must roam about in search of sustenance Our robots internally powered and therefore does not really need food But we can provide this capacity nonetheless through a second evolutionary layer one that gives our robot the ability to wander around and explore

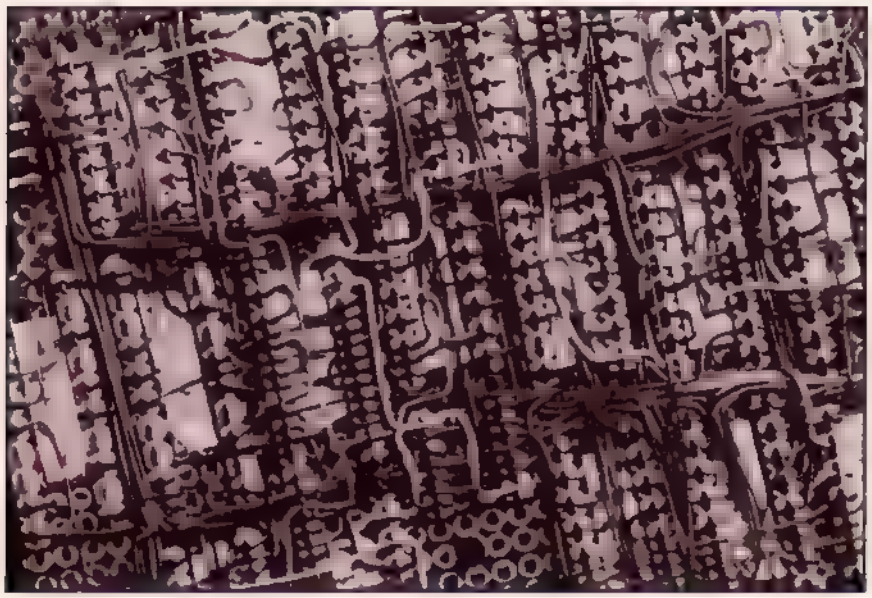
The simplest way to accomplish this we knew was to have the robot move forward But there was a problem How could we integrate the two systems—"runaway" and "explore"—so they would work together? If "explore" suppressed the commands of "runaway" for instance the creature would happily crash into walls On the other hand if we let "runaway" take priority the robot would oscillate backing at any obstruction in its path It would move forward until it saw the obstacle then backward until it lost sight of the obstruction then forward again and so on

A clever way to integrate the two behaviors we found was simply to alter "runaway" under certain conditions We augmented the equations that controlled our robot so that if it hit an obstacle while operating in the "explore" mode it wouldn't just back away but instead it would swerve around the roadblock and keep moving on in the forward direction Now our adventurous robot can behave like a barn swallow gracefully swooping through clouds of nutritious gnats without hitting houses or telephone poles

Even so this is not quite sufficient Given the speed of the exploring robot and the range of its sensors it has difficulty stopping on time To provide a human-size example it is like driving at superhighway speeds through thick fog If a deer jumps in front of your car taking your foot off the accelerator is not enough You must also slam on the brakes

When our robot was controlled only by "runaway" it never moved fast enough for crashing to be a problem The bug simply stopped accelerating when it sensed an obstacle and a bona fide accident was rare

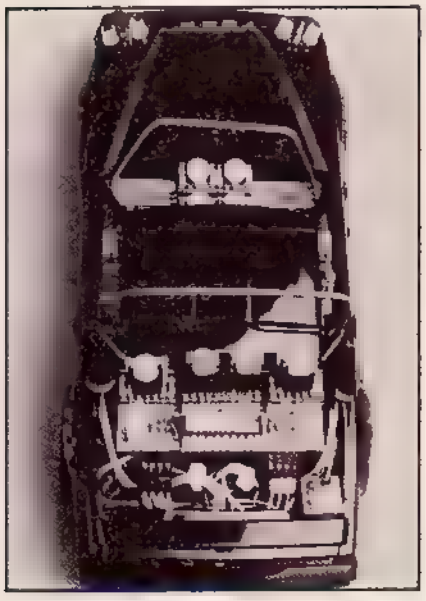
Under the influence of "explore" on the



other hand the vehicle continuously moves around, and its crash-and-bash proclivity becomes a threat to its very survival. Our solution yet another behavior one that allows the robot to explore its environment without destroying itself. Our little robot car still has no brakes but now, thanks to our modifications it does the next best thing— it slams itself briefly into reverse and comes to a screeching halt.

We refined the 'explore' part of our robot's brain further still by putting a clock onboard. We programmed the robot to veer to the right with each tick of the clock and as a result when moving through wide open spaces the robot presses forward in slowly gyrating circles creating a sort of spiral.

The circle in fact becomes the creature's territory and using the simple behaviors we have already created each robot defends its circle appropriately. For instance if a second robot enters the circle created by a first two things can happen. If the interloper 'sees' the claimant first, it will follow common courtesy and change its path. Conversely if the original robot detects the intruder it will adjust its own circle to respect the settler's rights.



Finally to really give our robot society a little pizzazz, we added a third layer of control a third behavior one that engenders an aggressive gregarious mode of interaction. We called this behavior "follow the leader." We created "follow the leader" quite simply. Instead of programming our robot to move directly away from obstacles we reprogrammed it to actively move toward objects it senses. To make sure our vehicle doesn't mow down the objects it is drawn to we modified the program so that the robot would come to a halt once it was sufficiently close to the target object.

The last problem we faced was deciding just when it would be appropriate for our robots to use 'follow the leader' behavior. It would not make sense, after all, to have 'follow the leader' switched on all the time. When a robot is in the 'explore' mode before it has found a suitable territory it needs to be able to maneuver around fixed features of the environment until it finds an empty space it can call its own. If follow were turned on right from the beginning the robot would find the nearest obstacle and park in front of it. It would worship the first table leg it came to as if the object were a totem pole and it would never budge.

Our solution was pretty clear cut. We programmed the robot so that if the front sensor detected objects on a continuous basis 'follow the leader' was automatically turned off and the robot maneuvered around obstacles to explore new terrain. If the front sensor detected no obstacles for a long period of time however we assumed that the robot had found virgin territory and 'follow the leader' switched on.

This last behavior allows our robots to truly relate to one another. Before when two robots met they simply shied away from each other. But now if one has established its territory and is approached by a second they actually interact. If a circling robot sees the backside of a wandering robot still in the 'explore' mode for instance it will latch on and try to follow the wanderer. If the two meet head to-head on the other hand the local robot attacks the visitor by driving straight toward him. If the visitor is still in the 'explore' mode it will run away and leave the local robot's territory. If however the visitor has already staked out a territory that overlaps that of the first robot, the two robots will have a face-off. The robots park nose to nose and glare until one of them yields its territory by switching out of the 'follow' mode.

TO GIVE OUR ROBOTS A LITTLE BIT OF PIZZAZZ, WE ADDED A THIRD BEHAVIOR, ENGENDERING FORCEFUL, AGGRESSIVE MODES OF INTERACTION. ROBOT INSECTS USING "FOLLOW" CAN MATE, GO TO WAR, OR STARE ONE ANOTHER OFF.

Such is the life of the robot at MIT. It is born and immediately starts exploring the world in search of a territory. When a suitable area is found, it patiently patrols the perimeter watching for other robots. Eventually it encounters another member of its species and either drives it away or decides that it is a potential mate and follows it. Those of us in the mobile robot lab in fact are continually amazed at the sophisticated behavior that has emerged from our simple systems.

While I have summarized the major aspects of our creatures' lives there is no substitute for firsthand observation. So the rest of this article describes how you can build an artificial insect of your own.

A ROBOT OF YOUR OWN

The robot described above is a bit too complex for the hobbyist to build easily at home. Instead in response to *Omni*'s request I designed a modified version that nonetheless illustrates the concept of the robot insect brain. The creature you will build has been named the photovore because its basic behavior is eating light. It has three photocells for eyes, two independent rear wheel motors and three logic chips for a brain. At an astoundingly low total cost of about $75 the photovore is perhaps the most sophisticated robot available to the hobbyist today.

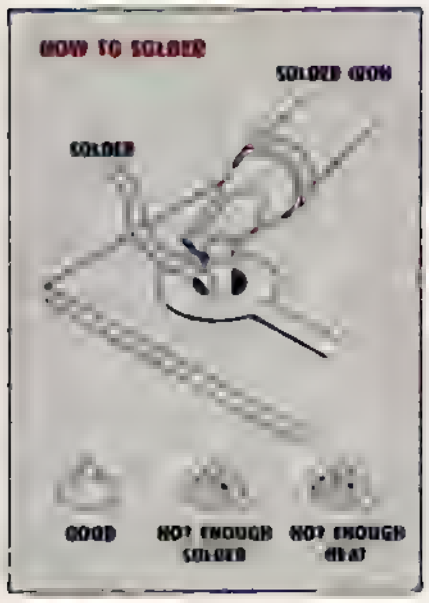
HOW TO BUILD THE PHOTOVORE

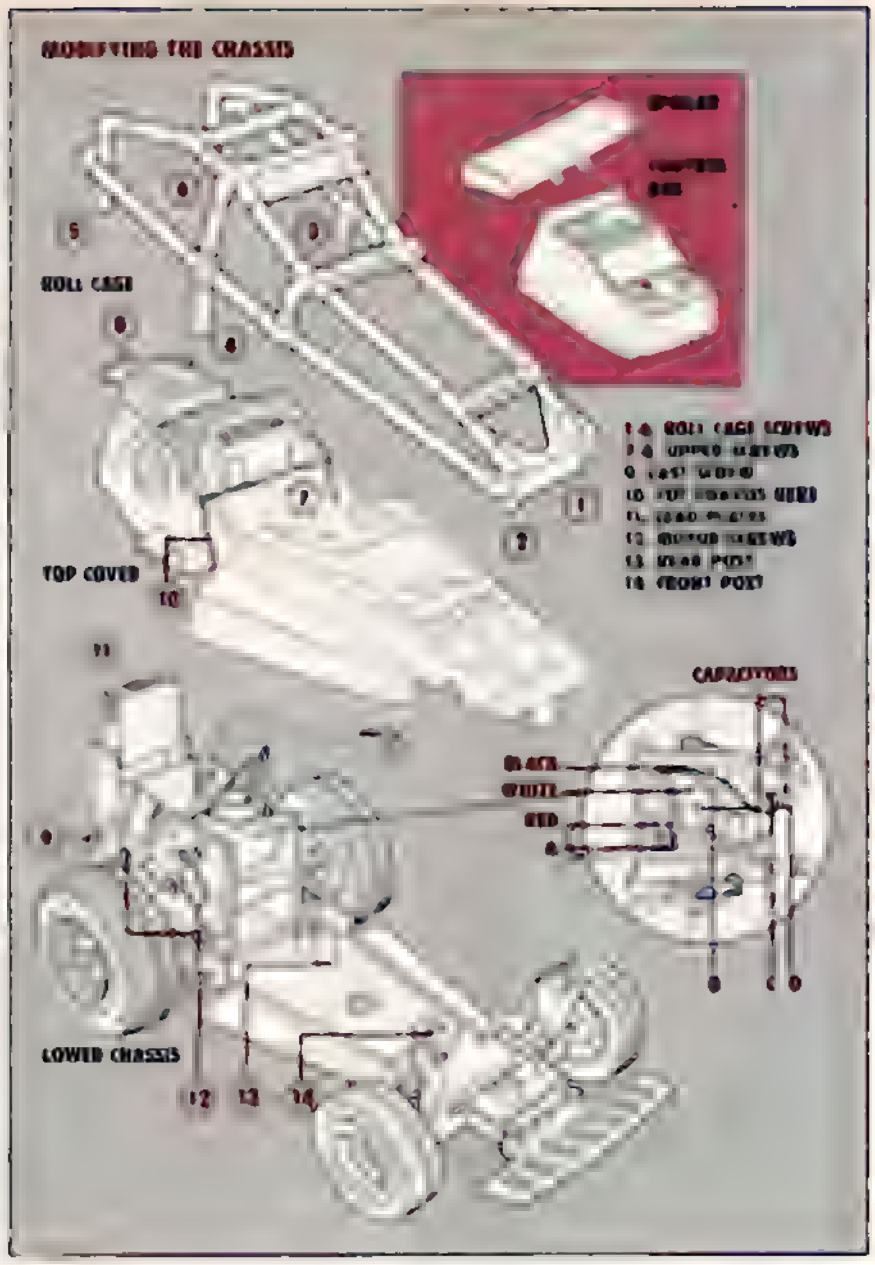
Before you start work you must acquire the parts on page 212. You can get the toy car from Radio Shack. The custom made circuit boards, along with a

detailed set of instructions, are available from Johnco Ltd. a Connecticut mail order supplier. All other parts are available either from your local electronics store, regular mail order supplier or Radio Shack. For your convenience we have included the Radio Shack part numbers along with the other information on page 212 at the end of this article.

LEARNING HOW TO SOLDER

Before you begin to build the photovore you must master the art of soldering. You can get solder and a soldering iron rated at 20 to 40 watts from most hardware or hobby stores. To solder simply touch the tip of the iron simultaneously to the two parts you are soldering together, and slowly feed solder into the junction. If you are working with the computer chips, touch the tip of the soldering iron simultaneously to the pin or lead of the component being installed and to the printed circuit board pad. Then from


HOW TO SOLDER
SOLDER GLOW
SOLDER
GOOD
NOT ENOUGH SOLDER
NOT ENOUGH HEAT


MODIFYING THE CHASSIS
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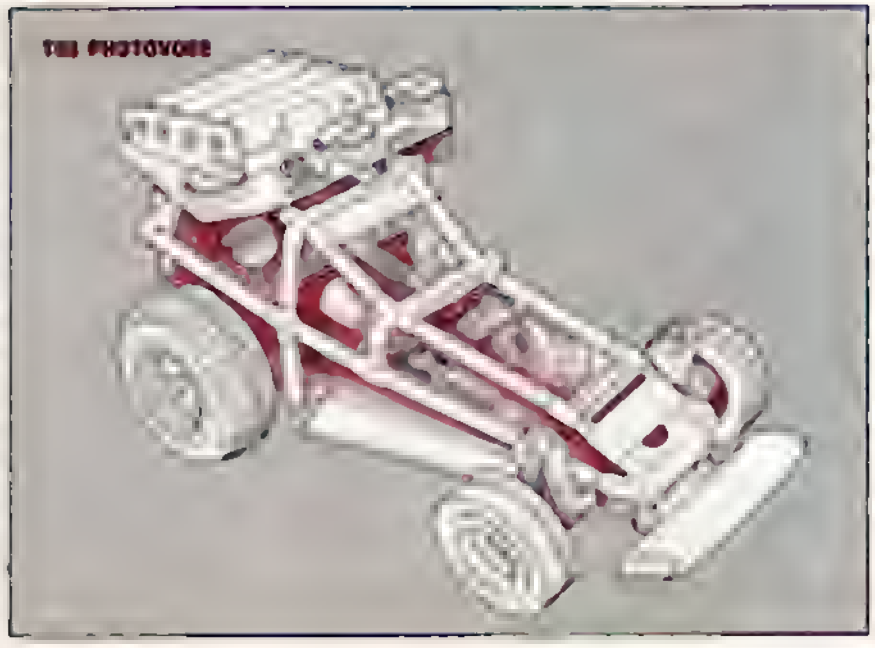
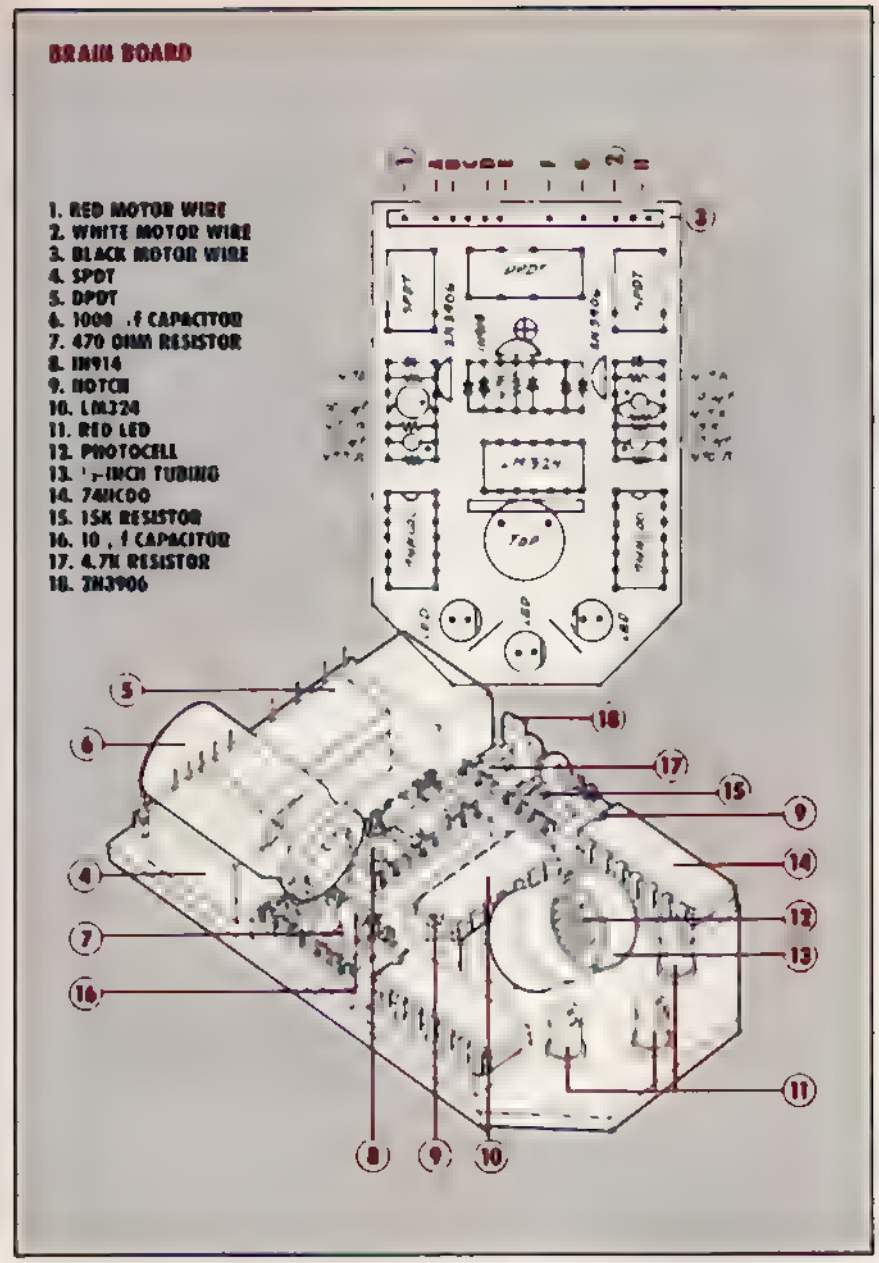
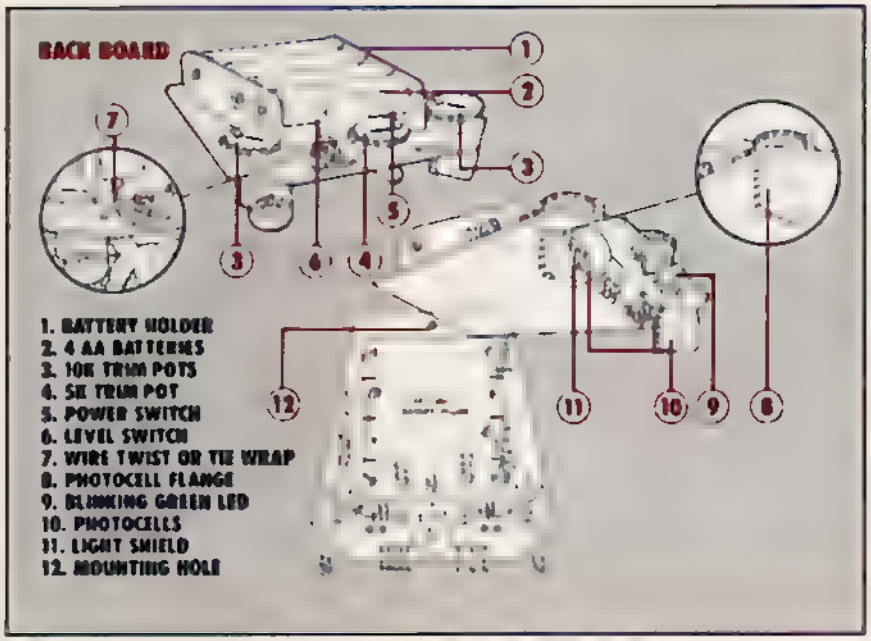

THE PHOTOVORE





the cable to the control box roughly eight inches from the motors and desolder all three wires in the cable and the white jumper running between the motors.

Now solder a 0.1 µf capacitor across the terminals of each motor and run a 22 gauge jumper from the rear terminal of the top motor (labeled B) to the top terminal of the rear motor (C). When doing this, remember to follow the tinning instructions given above.

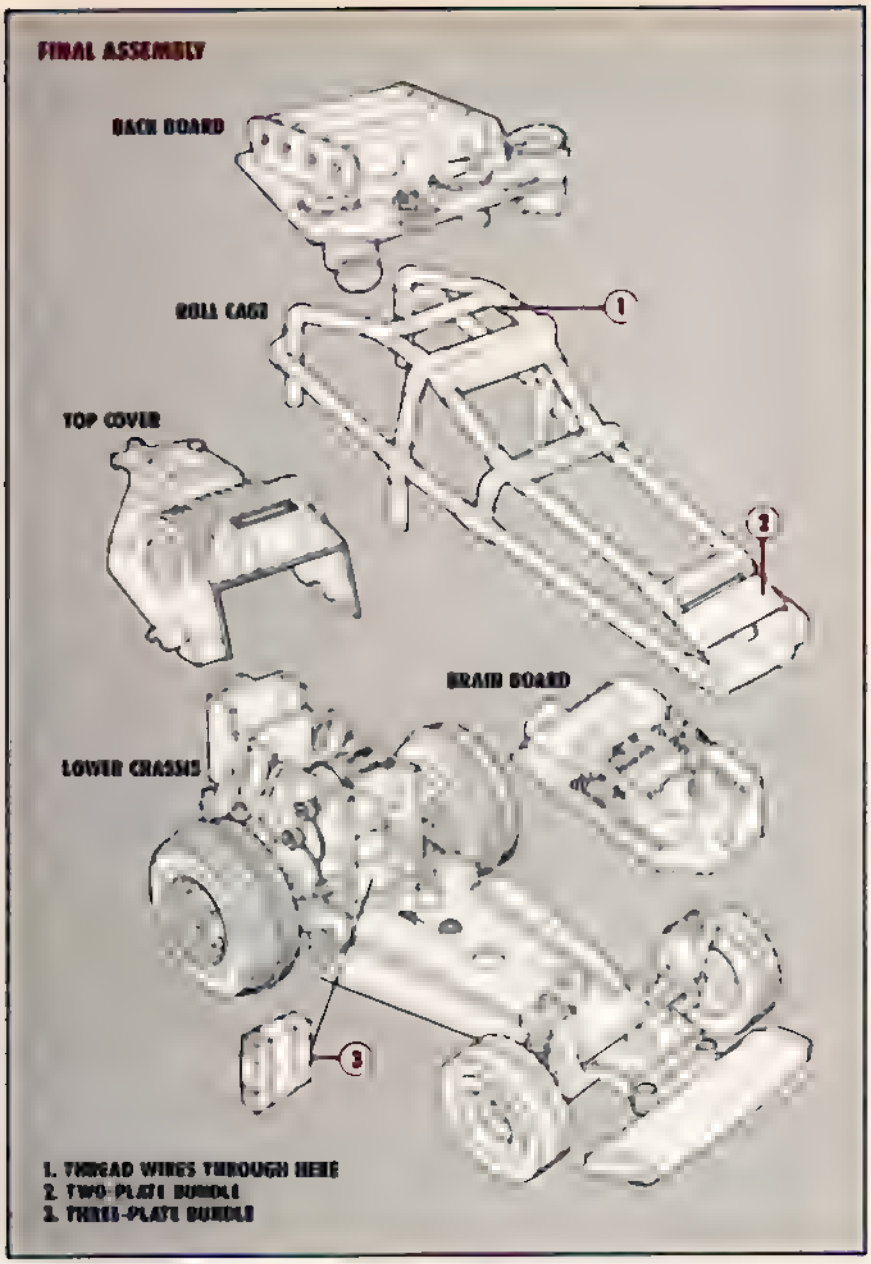
The last step is to solder the three-wire cable to location C. Connect the white wire to the jumper just installed at point B. The black wire goes to the bottom terminal of the rear motor (C), while the red wire goes to the front terminal of the top motor (A). Knot the completed cable around the plastic post beneath the front motor to provide strain relief. When all is done, reinstall the four screws that hold the motor assembly to the lower chassis.

When you have finished, you should have a chassis for your robot, plus some parts you will either discard or save for later. Make sure you save all screws, the roll cage, the shortened black cover, lead plates and the lower chassis. You may discard the control box and cable, the spoiler and the front half of the top cover.

WE CALLED THE CREATURE A PHOTOVORE BECAUSE ITS PRIMARY BEHAVIOR IS EATING LIGHT. ITS EYES ARE FASHIONED FROM THREE PHOTOCELLS. IT HAS LOGIC CHIPS FOR ITS BRAIN AND INDEPENDENT MOTORS TO CONTROL ITS REAR WHEELS.

BUILDING THE BRAIN BOARD

The brain board is one of the two circuit boards — this one happens to contain the brain that controls the robot. To set it into action, you must install the components into the circuit board as shown in the illustration labeled BRAIN BOARD. It is a good idea to apply silicone glue to the bottom of the larger components, such as the relays and IC sockets, to keep them in place while soldering. For the rest of the devices, simply insert their leads in the holes and bend them slightly to hold the devices in place. Double-check that the parts are oriented correctly. Look for the flat side on the light-emitting diodes (LEDs), the black band on the diodes, the flat surface on the transistors and the tiny + signs on the capacitors. The large capacitor has a black streak which is the terminal. After you have soldered the parts in place, snip off the rest of their protruding leads. Finally, epoxy the 0.3-by-0.6-inch photocell ridge onto the board as shown. When the epoxy is dry, apply a large glob of silicone glue in front of the ridge and then solder the photocell to the board. Cut a half-inch piece of half-



inch diameter shrink tubing, and slip this over the photocell. As the last step, press the three integrated circuits (marked 74HC00 (two chips) and LM324 chip) into their sockets.

BUILDING THE BACK BOARD

The back board (see illustration on the bottom of page 204) is the second of the photovores two circuit boards. To construct, install the battery holder using silicone glue, then solder it in place as shown. Next, install the two switches and the trim pots as shown. Note that the two 10K pots go in the edges of the board while the 5K pot is installed in the center. Once again use silicone glue to hold the parts in place. Use epoxy to glue the two photocell flanges onto the underside of the board as shown. When the glue is dry, insert the photocells as shown and secure them with silicone glue. Once again cut a half inch section of half inch diameter shrink tubing for each photo

el and slip the pieces on to form a light shield. Finally, you are ready to install the ground (GND) wire. Leave the power switch (SW1) and the photocells (PC) and insert the wire (stripped at the ends) in the center hole of the back board. Solder in place.

FINAL ASSEMBLY

Cut eight pieces of 22 gauge stranded wire (red) to 2 inches. The wires should be stripped approximately 1/4 inch at each end. Insert one end of each wire into the holes labeled A through H on the corresponding connector on the brain board. Thread the wire through the small rectangular opening at the back of the roll cage and solder the other end to the corresponding contact on the brain board. Now solder the three motor wires to the brain board in the slots indicated on the diagram. White is at the middle rear is on the right (as viewed from the back of the car) and black is on the left. Take the five lead plates from the back of the car and use electrical tape to make one bundle of three plates and one bundle of two plates. Tape the two bundles to the front of the roll cage as shown. Tape the three plate bundle to the plastic post under the top motor. Now screw the brain board to the lower chassis post that you cut down earlier. Replace the motor cover and secure it with a single screw from the bottom. Next, reattach the roll cage using the six original screws. Insert one large screw at the rear of the back board and use two loops of wire or two eyelets to secure the front of the board as shown in the final assembly diagram. Remember to install four double A batteries in the battery holder.

TO INTERACT WELL WITH THE WORLD, OUR ROBOTS REQUIRE A SCAFFOLD—A SKELETON FROM WHICH ORGANS AND SENSORS HANG. AT MIT WE OFTEN CONSTRUCT BODIES USING CHASSIS FROM REMOTE-CONTROLLED TOY VEHICLES.

INSECT TRAINING CAMP

Now that you have finished building the photovore, shown in its entirety at the bottom of page 204, you'll want to learn some basic games. Indeed, as far as robots go, the photovore is one of the few that is sufficiently complex to seem at least somewhat lifelike. The robot can wander around the room, run away from objects in its path and in many ways "react" to its environment as a creature, as a real bug.

The more behaviors with so much sophistication because, like the artificial bugs at MIT, it has been designed in layers. The lowest layer basically is a behavior "See a light." It causes the two photocells to move to-

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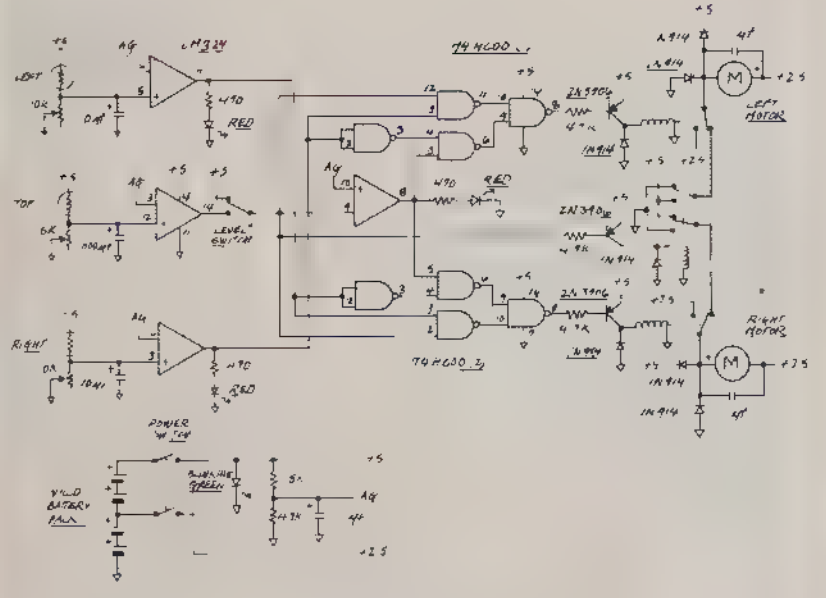
CIRCUIT DIAGRAM



ward the light. If it sees total darkness on all sides, it simply stops.

Using just the behaviors in level one, there are two ways to play with the 'vore.

The first and most obvious is to darken the room and tune the sensors so they react to bright light. Next take a flashlight and shine it at the robot. The creature will scurry toward the light and try to home in on you wherever you move.

The second way to play with the 'vore involves leaving the lights on. Now the creature will keep moving forward, yet swerve around obstacles or dark areas in its path. If it's wandering down a long hallway with dark baseboards, it will avoid the walls and even turn around at the end.

While this behavior pattern works pretty well, the 'vore often winds up in inaccessible niches under the furniture, with no light in view. If it is programmed merely to go toward light, it simply will not move under this circumstance.

To start it on its way, you can flip a switch to invoke the robot's second personality, called "back." "Back" instructs the robot to back away from the darkness instead of moving toward light. The robot can be propelled by "back" until it reaches a clearing. Once out in the light, "back" switches off and "seek" takes control once more. For instance, if the 'vore wanders into a dark area such as under a table, it will stop in its tracks, turn around, and move back toward the light.

The 'vore even has an idiosyncrasy that you may use to astound your friends. Sometimes the bug will get itself into a dimly lit corner, though it may still be bright overhead, neither one of the side sensors sees the light. In this case, the 'vore will stop. If however you lean over it to pick it up (making sure the switch is in the "back" mode), the photovore will wake up and scuttle backward. This occurs because as you lean you are casting a shadow on its back sensor.

This simple creature exhibits a wide range of skills. If you are particularly creative, you can make your robot smarter still by adding such features as a bump detector or a cliff finder. The wonderful thing about building brains in layers is that you can start with something simple and add capabilities as you go along.

FUN AND GAMES

For quick instructions on operating the photovore, follow the tutorial below, and consult the FUN AND GAMES diagram on page 206. In the first game, called Flashlight, the photovore drives toward sources of light in a dark room. To activate the robot for Flashlight, set switches as shown in the top half of the diagram. Set the side dials clockwise as far as they can go.

In the second game, called Wander, the photovore explores a room by seeking light sources as before and by backing away from areas that are dark. To activate Wander, set the switches as shown in the bottom half of the diagram. Then

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adjust the side dials so that the LEDs just turn on (the arrow should be pointing virtually straight up) and adjust the center dial until the center LED just turns off.

The best way to tune the sensors is to place the photovore on the floor near the edge of a room and point it toward the center of the room. Then lift the back wheels slightly off the ground and adjust the switches and knobs as described above. Good luck, and enjoy!

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The brain board and back board can be custom ordered for $25 from Johuco Ltd., Box 390, Vernon, CT 06066. Connecticut residents should add $1.88 for sales tax.

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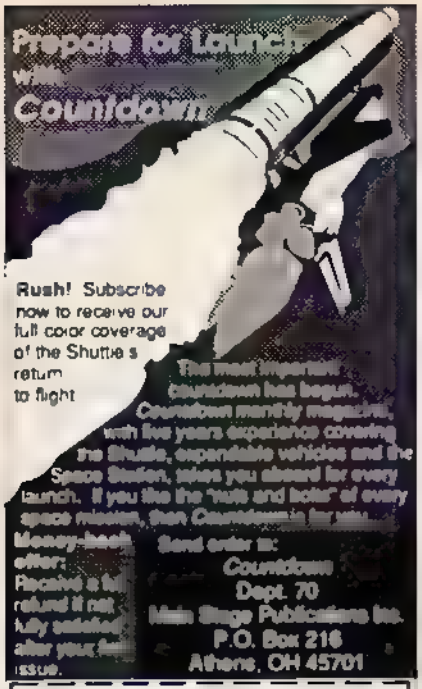

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OMNI MIND

CONTINUED FROM PAGE 34

dying within the next 15 years than low scorers. Suspicious people, Barefoot speculates, "may generate stress for themselves by creating antagonistic interactions or perceiving threat when it may not be there. Having worse relations with others, they may have less help in coping with stress. This could mean a greater likelihood of stress-related death," he says.

Ray Rosenman, director of cardiovascular research at SRI International in Menlo Park, California, questions the interpretation of Williams's and Barefoot's work. "You can't just make up terms like suspiciousness or cynicism," he says. But most researchers in psychosomatic medicine respect the test; its validity has been proved over the years. "Well sure, Type A will be a little more suspicious, a little less trusting," counters Rosenman. "But you have to look at why these people are this way."

"Personality," responds Williams, "is determined by the interplay between neurobiological makeup, which is in part genetically determined, and the experiences the individual is exposed to during critical phases of development. He is now trying to determine the biological mechanism that accounts for high mortality in people who are suspicious, cynical and mistrusting. In his latest experiment, he divided subjects into two groups according to testing profiles, one hostile, the other not. He injected both groups with isoproterenol, a potent form of the stress hormone epinephrine, and with norepinephrine, a neurotransmitter that can constrict blood vessels and direct blood flow to the heart and muscles.

Williams compared the responses of the two groups by measuring the T wave amplitude (TWA) of their ECGs (electrocardiograms). A smaller amplitude indicates that the heart, bombarded by the stress hormones, is working harder. When the TWA returns to normal—as it did more quickly in the nonhostile group—it means the heart is recovering from the stress. "This quick TWA recovery suggests there's a 'brake' in this group that's activated to stop the heart's overstimulation," he says. Subjects with poor TWA recovery—those in the hostile group—also had higher resting levels of the stress hormone cortisol in their blood. And they released more of it under stress.

The higher levels affect the heart, the blood vessels, the outpouring of fat into the bloodstream," concludes Williams. "It could play a role in coronary disease and health in general because these hormones have negative effects on the immune system." Williams counsels hostile patients at the Duke Medical Clinic to think that their negative emotions are as bad as eating fatty foods or smoking. It's a mind-set they can alter, he says. ∞

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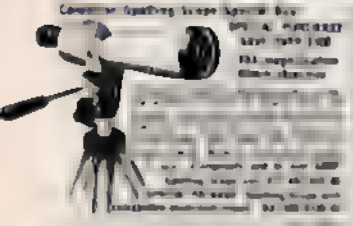

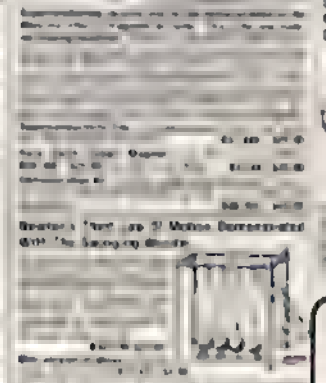

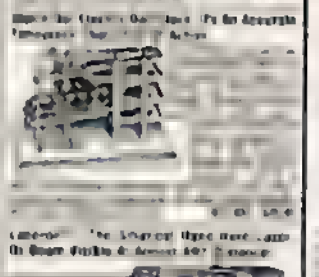

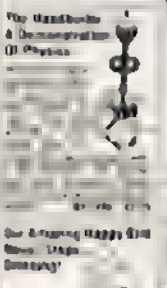

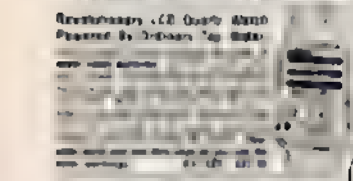

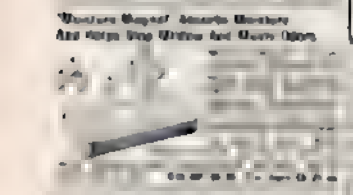

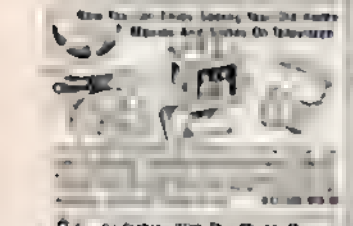

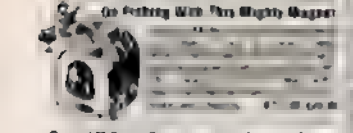

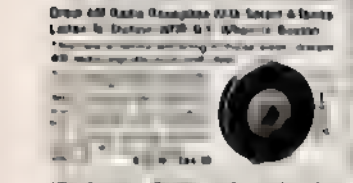

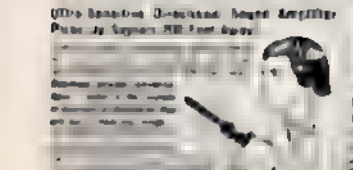

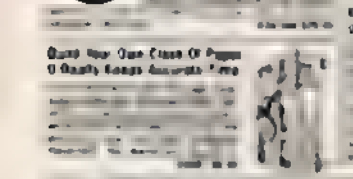

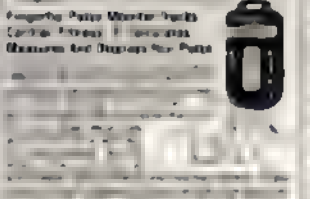

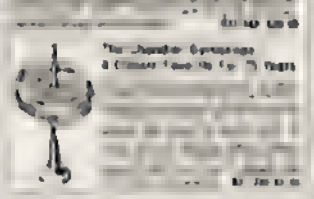

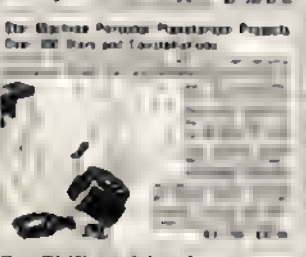

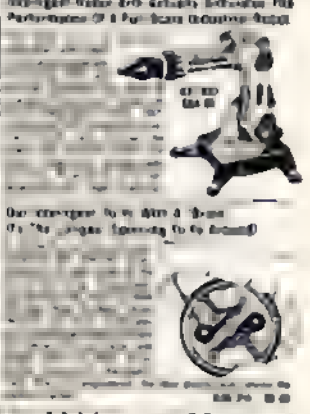

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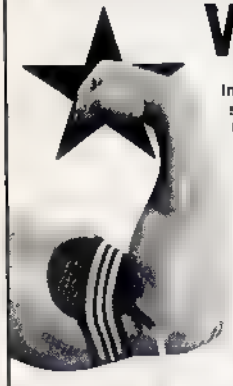

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ARTS

CONTINUED FROM PAGE 46

Show presented its Innovations 1988 Software Award to video game packager Acclaim Entertainment's *Wizards and Warriors*. Cited for its "superb graphics, enchanting storyline, and riveting sound track," the fantasy adventure game was created in England by Rare, a group Acclaim president Gregory Fischbach calls "the George Lucas and Steven Spielberg of video games."

Today's games have multiple levels, each progressively more difficult. In Nintendo's *Mike Tyson's Punch-Out!!*, for example, players are matched with 11 fighters possessing different abilities and styles. Stover, who's also director of marketing for FNN's sports division, arranged to have *Mike Tyson's Punch-Out!!* reviewed on FNN's boxing show *Ring Rap*, he says. "We believe that the game so closely represents real boxing that we can do a fairly straightforward analysis of the game and not be completely ridiculous," he explains.

Creativity is also a component of the games. Players must think up twists, turns, and action moves as well as overcome the obstacles that give each game its own unique character. "The best games make your nerves jump and your blood race," says Laura Lenk, a Lorimar television production manager.

Adults, however, don't seem to be interested in games that require only skill. They're attracted to the more intellectual games, those that require strategy and decision making. Games like *The Legend of Zelda*, an extremely popular nonstop role-playing fantasy-adventure, involve knowledge of the characters, second-guessing, and taking control. *Zelda* software, moreover, stores players' progress, allowing them to return to the game and take up where they left off.

"*The Legend of Zelda* is incredibly intricate," says Nissenson, who has mapped out the game's nine levels. "It's an intellectual exercise requiring you to program your thinking. There are certain logical consistencies that take quite a while to understand, but then you begin to think like the game's programmer."

Pointing out that she has many other interests and doesn't "vegetate in front of the video games," Nissenson adds that "video games are an interesting therapy for adults. They demand the kind of attention that makes you take your focus off personal problems and anxieties."

They're certainly not for wimps, however. Nintendo video game enthusiasts also include such professional athletes as Greg Maddux and his teammates on baseball's Chicago Cubs, as well as Ron Morris and others on football's Chicago Bears. In future issues, look for their comments and tips, plus other cutting-edge information on video games. ∞

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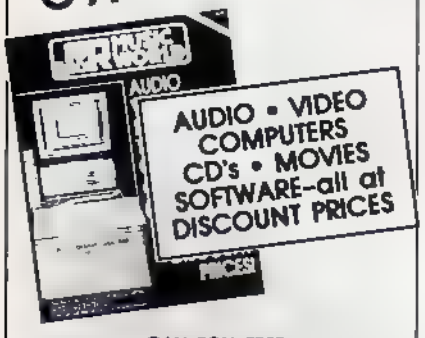

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STARS

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polished and cut. A test mirror cut three years ago, warped about half a micron—50 atoms across. Nelson, who designed the mirror, believes they have now refined the process. The first mirror warped about 120 nanometers, or 0.12 micron—one hundredth the width of a human hair. "That's a significant amount," says Keck project manager Jerry Smith, "but it can be corrected either with a small harness to warp it back into shape or with computer polishing."

Even so, the uncertainty remains. Just because mirror segment number one has a warp of 0.12 micron doesn't mean that mirror number two won't warp twice as badly. The ultimate test will come when the engineers perform the final optical figuring. They will have to form all 36 segments, each with its own peculiarities, into one gigantic hyperboloid, held in focus by continuous computer alignment.

A big scope's troubles don't end with a single alignment, however. Fluctuations in heat or cold also cause mirrors to change shape, which hampers their ability to focus light. A typical single heavy mirror also requires a very large tube to support it. The Keck's designers hope to avoid these problems, too. The thin mirror segments adjust quickly to changes in temperature, and they are lighter than a single mirror. This means the telescope can be both cheaper and smaller than a one-piece mirror telescope of the same diameter. The $87 million 400-inch Keck, for example, has a short focal length. It can fit into a dome about the same size as that of the 200-inch Hale—which cost $6 million in 1928, or about $120 million in 1980 dollars.

The workers have finished building the Keck's final resting place, a dome high atop Mauna Kea in Hawaii. The site, already a popular spot for astronomy, is the highest point of land in the Pacific and affords the advantages of dark, clear night skies and an undisturbed overhead airstream. By next spring workers plan to install the telescope itself. Then they will mount the mirrors. If all goes well, the Keck will experience "first light"—its inaugural viewing run—in 1990. Sometime in 1991 astronomers hope to take the Keck's controls and use it to peer for the first time at a celestial object.

Should this ambitious project work out as planned, the mighty Keck telescope will let the earthbound gather the faintest, most distant light ever observed from the cosmos. This includes distant quasars the Big Bang blew so far away that the light now reaching us began its journey when the universe was but one fifth its current age. Says Nelson, "We'll be able to look back a long way, to a time when the universe was probably very different than it is now." ∞

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PARENTS

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called starfish—they're not fish). Known for their powers of regeneration, sea stars will regrow a lost arm. More surprisingly, the detached arm will sprout a whole new organism—a clone of the original sea star. For true reproduction, you need a he and a she star.

Reptiles regenerate lost limbs and tails, sometimes replacing the missing one with two—not a pretty sight.

Herpetologists, who study reptiles and amphibians, long suspected that some lizard populations are all female, capable of cloning themselves. To prove this, scientists would have to raise generation after generation in a laboratory. The controlled environment would ensure that there were no males on midnight jaunts.

In 1978 Charles Cole, working with the American Museum of Natural History, successfully bred an all-female species of whiptail lizard that clones itself. This new hybrid species has done away with males and their services.

Salamanders, like some of their lizard cousins, have also been mating with close relatives. The Jefferson and blue-spotted salamanders interbred, creating silvery and Tremblay all-female hybrids. Seemingly unparticular about their partners in the beginning, now the Jeffersons will mate only with the silverys, and the blues with the Tremblays. The contribution of sperm serves as a stimulant for egg development—no genetic material is interchanged. The all-female hybrids' offspring are cloned daughters. Research is being done on the closely related green and grass frogs. These species are breeding in the wild, also producing female offspring suspected of being capable of asexual reproduction. (Things are not looking good for males.)

Social insects, it seems, are not as social as we're led to believe. Most people know who rules the beehive—a large female. The queen is cared for by the colony majority—the workers, who are small females. The odd few left in the nest are drones, males born from the queen's unfertilized eggs. Their sole purpose is to grow up, chase the queen, and mate with her. Had the drones any intelligence, they would probably escape before autumn, when this little scenario occurs. What initially appears lucky—the task of getting to the queen—is actually rather nasty. The queen keeps the male's genitalia (a trophy?), ripping it out, along with most of his intestines (a statement?). By the end of the mating season, the remainder of the drones are starved or stung to death by the female workers (jealousy?). Somewhere in here lies a rewrite of the birds-and-the-bees story.

Certain members of the walkingstick family are also known to reproduce without mating. (Seemingly misnamed, it doesn't do a lot of walking but rather spends most of its time hiding from prey.) Perhaps this loner got wind of the mating ritual of its cousin the praying mantis and decided that a dull walkingstick is better than a devoured one.

The cleaner wrasse fish prey on the parasites found on larger fish. In exchange for services rendered, the wrasse is spared being eaten by its carnivorous host. Sexually, the cleaner wrasse is a confused, indecisive species. They go back and forth between being male and female, which can make dating precarious but mating advantageous.

For bacteria, binary fission is the usual mode of reproduction—the parent cell pinches in the middle and divides into two daughter cells. But some bacteria can reproduce sexually, like the bacteria responsible for dysentery. The male and female of the shigella strain, a rod-shaped bacterium, combine genetic material by making transient physical contact—casual collisions (sound familiar?). Hardly a flamboyant mating ritual, it is nevertheless effective. Mycoplasmas, the simplest living cells known, also reproduce through binary fission.

All-female species that clone are assured of thriving—the strongest survive and duplicate themselves. But what if the environment changes? Sexual reproduction adds flexibility to the species by introducing rare, favorable changes. Populations may grow faster within asexual female species, but these rigid families also become extinct more quickly. We're not ready to dispense with males yet.—Nina Guccione and Joe Fodor

HANNIBAL'S

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propose to violate your trust and go sneaking into the midst of the invading force, as a mere prank?"

"I guess I do," he said

"This is an extremely cockeyed idea, isn't it?" said

"Absolutely. Are you with me?"

"Sure," I said. "You know I am."

I told Elaine that Tim and I were going to meet for a late dinner to discuss a business deal and I didn't expect to be home until two or three in the morning. No problem there. Tim was waiting at our old table at Perugino's with a bottle of Amarone already working. The wine was so good that we ordered another midway through the veal pizzaiola, and then a third. I won't say we drank ourselves blind, but we certainly got seriously myopic. And about midnight we walked over to the park.

Everything was quiet. I saw sleepy-looking guardsmen patrolling here and there along Fifth Avenue. We went right up to the command post at Fifty-ninth, and Tim saluted very crisply, which I don't think was quite kosher, he being not then in uniform. He introduced me to someone as Dr. Pritchett, Bureau of External Affairs. That sounded really cool and glib. Bureau of External Affairs.

Then off we went up Fifth, Tim and I, and he gave me a guided tour. "You see, Dr. Pritchett, the first line of the isolation zone is the barricade that runs down the middle of the avenue." While, forceful voice loud enough to be heard for half a block: "That keeps the gawkers away. Behind that, Doctor, we maintain a further level of security through a series of augmented-beam sealfield emplacements, the new General Dynamics 1100 series model, and let me show you right here how we've integrated that with advanced personnel interface intercept scan by means of a triple line of Hewlett-Packard optical doppler-couplers."

And so on, a steady stream of booming confident-sounding gibberish as we headed north. He pulled out a flashlight and led me hither and thither to show me amplifiers and sensors and whatnot, and it was Dr. Pritchett this and Dr. Pritchett that, and I realized that we were now somehow on the inner side of the barricade. His glibness, his poise, were awesome. "Notice this, Dr. Pritchett, and let me call your attention to this, Dr. Pritchett," and suddenly there was a tiny digital keyboard in his hand, like a little calculator, and he was tapping out numbers. "Okay," he said, "the feeds down between here and the Sixty-fifth Street entrance to the park, but I've put a kill on the beam-interruption signal. So far as anyone can tell there's still an unbroken field. Let's go in."

And we entered the park just north of the zoo.

For five generations the first thing New York kids have been taught—ahead of tying shoelaces and flushing after you go—is that you don't set foot in Central Park at night. Now here we were, defying the most primordial of no-no's. But what was to fear? What they taught us to worry about in the park was muggers. Not creatures from the Ninth Glorch Galaxy.

The park was eerily quiet. Maybe a snore or two from the direction of the zoo, otherwise not a sound. We walked west and north into the silence, into the darkness. After a while a strange smell reached my nostrils. It was dank and musky and harsh and sour, but those are only approximations. It wasn't like anything I had ever smelled before.

One whiff of it and I was seeing purple skies and a great green sun blazing high in the heavens. A second whiff and all the stars were in the wrong places. A third whiff and I was staring into a gnarled, twisted landscape where the trees were like giant spears and the mountains were like crooked teeth.

Tim nudged me.

"Yeah," I said. "I smell it too."

"Look to your left," he said.

I looked to my left and saw three huge yellow eyes looking back at me from twenty feet overhead, like searchlights mounted on a tree. They weren't mounted in a tree, though. They were mounted in something shaggy and massive, somewhat larger than your basic two-family Queens residential dwelling, that was standing maybe fifty feet away, completely blocking both lanes of the park's East Drive from shoulder to shoulder.

It was then that I realized that three bottles of wine hadn't been nearly enough.

"What's the matter?" Tim said. "This is what we came for, isn't it, old pal?"

"What do we do now? Climb on its back and go for a ride?"

"You know that no human being in all of history has ever been as close to that thing as we are now?"

"Yes," I said. "I do know that, Tim."

It began making a sound. It was the kind of sound that a piece of chalk twelve feet thick would make if it was dragged across a blackboard the wrong way. When I heard that sound I felt as if I was being dragged across whole galaxies by my hair. A weird vertigo attacked me. Then the creature folded up all its legs and came down to ground level and then it unfolded the two front pairs of legs, and then the other two, and then it started to amble slowly and ominously toward us.

I saw another one, looking even bigger, just beyond it. And perhaps a third one a little farther back. They were heading our way, too.

"Shit," I said. "This was a very dumb idea, wasn't it?"

"Come on. We're never going to forget this night."

"I'd like to live to remember it."

"Let's get up real close. They don't move very fast."

"No," I said. "Let's just get out of the park right now, okay?"

"We just got here."

"Fine," I said. "We did it. Now let's go."

"Hey, look," Tim said. "Over there to the west."

I followed his pointing arm and saw two gleaming wraiths hovering just above the ground, maybe three hundred yards away. The other aliens, the little floating ones. Drifting toward us, graceful as balloons. I imagined myself being wrapped in a shining pillow and being floated off into their ship.

"Oh, shit," I said. "Come *on*, Tim."

Staggering, stumbling, I ran for the park gate, not even thinking about how I was going to get through the sealfield without Tim's gizmo. But then there was Tim, right behind me. We reached the sealfield together, and he tapped out the numbers on the little keyboard, and the field opened for us, and out we went, and the field closed behind us. And we collapsed just outside the park, panting, gasping, laughing like lunatics, and slapping the sidewalk hysterically. "Dr. Pritchett," he chortled. "Bureau of External Affairs. God *damn*, what a smell that critter had! God *damn*!

I laughed all the way home. I was still laughing when I got into bed. Elaine squinted at me. She wasn't amused. "That Tim," I said. "That wild man Tim." She could tell I'd been drinking some, and she nodded somberly—boys will be boys, etcetera—and went back to sleep.

In the morning I learned what had happened in the park after the two of us had cleared out.

It seemed a few of the big aliens had gone looking for us. They had followed our spoor all the way to the park gate, and when they lost it they somehow turned to the right and went blundering into the zoo. The Central Park Zoo is a small cramped place, and as they rambled around in it they managed to knock down most of the fences. I'm not sure what-ever there were tigers, elephants, chimps, rhinos, and hyenas all over the park.

The animals, of course, were befuddled and bemused at finding themselves free. They took off in a hundred different directions, looking for places to hide.

The lions and coyotes simply curled up under bushes and went to sleep. The monkeys and some of the apes went into the trees. The aquatic things headed for the lake. One of the rhinos ambled out into the Mall and pushed over a fragile-looking alien machine with his nose. The machine shattered, and the rhino went up in a flash of yellow light and a puff of green smoke. As for the elephants, they stood poignantly in a huddled circle, glaring in utter amazement and dismay at the gigantic aliens. How humiliating it must have been for them to feel *tiny*.

Then there was the bison event. There was this little herd, a dozen or so mangy-looking guys with ragged, threadbare fur. They started moving single file toward Columbus Circle, probably figuring that if they just kept their heads down and didn't attract attention they could keep going all the way back to Wyoming. For some reason a behemoth decided to see what bison taste like. It came hulking over and sat down on the last one in the line, which vanished underneath it like a mouse beneath a hippopotamus. Chomp, gulp, gone. In the next few minutes five more behemoths came over and disappeared five more of the bison. The survivors made it safely to the edge of the park and huddled up against the sealfield, mooing forlornly. One of the little tragedies of interstellar war.

I found Tim on duty at the Fifty-ninth Street command post. He looked at me as though I were an emissary of Satan.

"Sorry, I can't talk to you while I'm on duty," he said.

"You heard about the zoo?" I asked.

"Of course I heard." He was speaking through clenched teeth. His eyes had the scarlet look of zero sleep. "What a filthy, irresponsible thing we did!"

"Look, Tim, we had no way of knowing that the—"

"Inexcusable. An incredible lapse. The aliens feel threatened now that humans have trespassed on their territory, and the whole situation has changed in there. We upset them, and now they're getting out of control. I'm thinking of reporting myself for court martial."

"Don't be silly, Tim. We trespassed for three minutes. The aliens didn't give a crap about it. They might have blundered into the zoo even if we hadn't—"

"Go away," he muttered. "I can't talk to you while I'm on duty."

Jesus. As if I was the one who had lured *him* into doing it. Well, he was back in his movie part again, the distinguished military figure who now had unaccountably committed an unpardonable lapse and was going to have to live in the cold glare of his own disapproval for the rest of his life. The poor bastard. I tried to tell him not to take things so much to heart, but he turned away from me, so I shrugged and went back to my office.

That afternoon some tenderhearted citizens demanded that the sealfields be switched off until the zoo animals could escape from the park. The sealfields, of course, kept them trapped in there with the aliens.

Another tough one for the mayor. He would lose points tremendously if the evening news kept showing our beloved polar bears and raccoons and kangaroos and whatnot getting gobbled like so

many gumdrops by the aliens. But switching off the sealfields would send a horde of leopards and gorillas and wolverines scampering out into the streets of Manhattan, to say nothing of the aliens who might follow them. The mayor appointed a study group, naturally.

The small aliens stayed close to their spaceship and remained uncommunicative. They went on tinkering with their machines, which emitted odd plinking noises and curious colored lights. But the huge ones roamed freely about the park, and now they were doing considerable damage in their amiable, mindless way. They smashed up the backstops of the baseball fields, tossed the Bethesda Fountain into the lake, rearranged Tavern on the Green's seating plan, and trashed the place in various other ways, but nobody seemed to object except the usual Friends of the Park civic types. I think we were all so bemused by the presence of genuine galactic beings that we didn't mind. We were flattered that they had chosen New York as the site of first contact. (But where *else*?)

No one could explain how the behemoths had penetrated the Seventy-second Street sealfield line, but a new barrier was set up at Seventy-ninth, and that seemed to keep them contained. Poor Tim spent twelve hours a day patrolling the perimeter of the occupied zone. Inevitably I began spending more time with Maranta than just lunchtimes. Elaine noticed. But I didn't notice her noticing.

One Sunday at dawn a behemoth turned up by the Metropolitan, peering in the window of the Egyptian courtyard. The authorities thought at first that there must be a gap in the Seventy-ninth Street sealfield, as there had been at Seventy-second. Then came a report of another alien out near Riverside Drive and a third one at Lincoln Center, and it became clear that the sealfields just didn't hold them back at all. They had simply never bothered to go beyond them before.

Making contact with a sealfield is said to be extremely unpleasant for any organism with a nervous system more complex than a squid's. Every neuron in your body screams out in anguish. You jump back, involuntarily, a reflex impossible to overcome. On the morning we came to call Crazy Sunday, the behemoths began walking through the fields as if they weren't there. The main thing about aliens is that they are alien. They feel no responsibility for fulfilling any of your expectations.

That weekend it was Bobby Christie's turn to have the full apartment. On those Sundays when Elaine and I had the one-room configuration, we liked to get up very early and spend the day out, since it was a little depressing to stay home with three rooms of furniture jammed all around us. As we were walking up Park Avenue South toward Forty-second, Elaine said suddenly, "Do you hear anything strange?"

"Strange?"

"Like a riot."

"It's nine o'clock Sunday morning. Nobody goes out rioting at nine o'clock Sunday morning."

"Just listen," she said.

There is no mistaking the characteristic sounds of a large, excited crowd of human beings, for those of us who spent our formative years living in the late twentieth century. Our ears were tuned at an early age to the music of riots, mobs, demonstrations, and their kin. We know what it means when individual exclamations of anger, indignation, or anxiety blend to create a symphonic hubbub in which all extremes of pitch and timbre are submerged into a single surging roar as deep as the booming of the surf. That was what I was hearing now. And there was no mistaking it.

"It isn't a riot," I said. "It's a mob. There's a subtle difference."

"What?"

"Come on," I said, breaking into a jog. "I'll bet you that the aliens have come out of the park."

A mob, yes. In a moment we saw thousands upon thousands of people filling Forty-second Street from curb to curb. What they were looking at—pointing, gaping, screaming—was a shaggy blue creature as big as a small mountain that was moving about uncertainly on the automobile viaduct that runs around the side of Grand Central Terminal. It looked unhappy. It was trying to get down from the viaduct, which was sagging noticeably under its weight. People were jammed right up against it, and a dozen or so were clinging to its sides and back like rock climbers. There were people underneath it, too, milling between its colossal legs. "Oh, look," Elaine said, shuddering, digging her fingers into my biceps. "Isn't it eating some of them? Like they did the bison?" Once she had pointed it out, I saw, yes, the behemoth now and then was dipping quickly and rising again, a familiar one-two, the old squat and gobble. "What an awful thing!" Elaine murmured. "Why don't they get out of its way?"

"I don't think they can," I said. "I think they're being pushed forward by the people behind them."

"Right into the jaws of that monster."

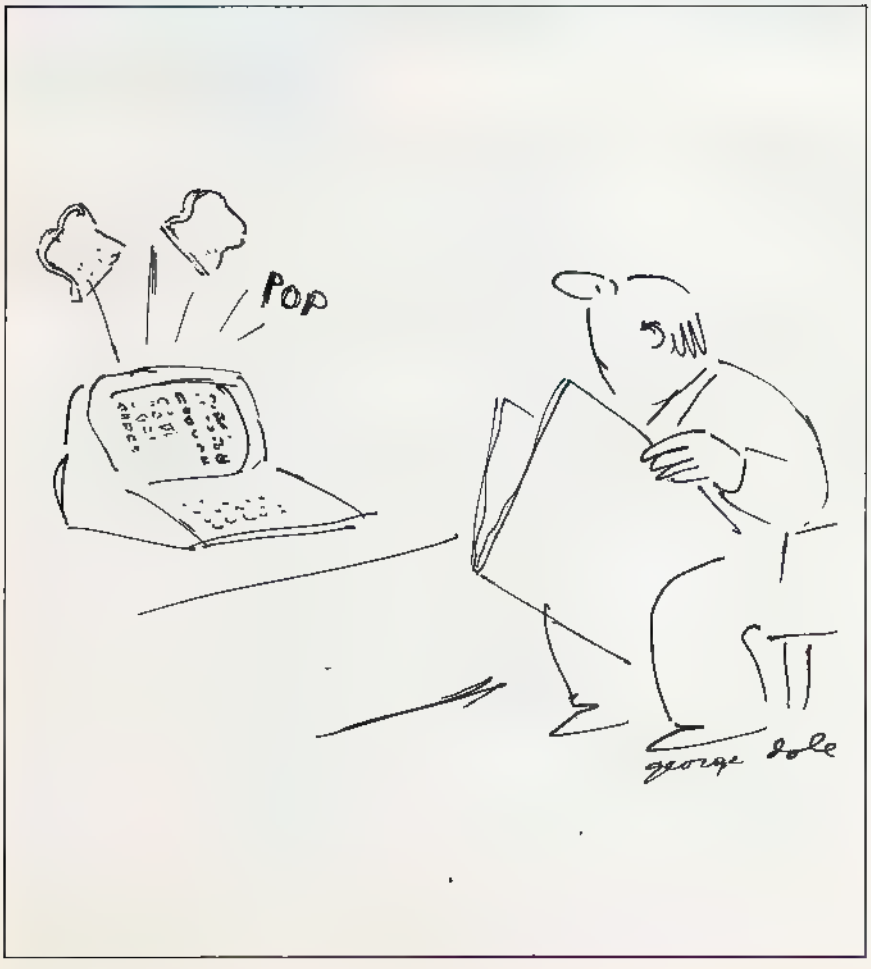
"I don't think it means to hurt anyone," I said. "How did I know that?" "I think it's just eating them because they're dithering around down there in its mouth area. A kind of automatic response. It looks awfully dumb, Elaine."

"Are you defending it?"

"Hey, look, Elaine—"

"It's *eating* people. You sound almost sorry for it."

"Why not? It's far from home and surrounded by ten thousand screaming mo-



rons. You think it wants to be there?"

"It's a disgusting obnoxious animal." She was getting furious. Her eyes were bright and wild, her jaw was thrust forward. "I hope the Army gets here fast. I hope they blow it to smithereens!"

Her ferocity frightened me. I saw an Elaine I scarcely knew at all. When I tried one more time to make excuses for that miserable hounded beast on the viaduct she glared at me with unmistakable loathing. Then she turned away and went rushing forward, shaking her fist, shouting curses and threats at the alien.

Suddenly I realized how it would have been if Hannibal actually had been able to keep his elephants alive long enough to enter Rome with them. The respectable Roman matrons, screaming and raging from the housetops with the fury of banshees. And the baffled elephants, sooner or later rounded up and thrust into the Colosseum to be tormented by little men with spears, while the crowd howled its delight. Well, I can howl, too. "Come on, behemoth!" I yelled into the roar of the mob. "You can do it, Goliath!" A traitor to the human race is what I was, I guess.

Eventually a detachment of guardsmen came with mortars and rifles, and for all I know they had tactical nukes, too. But of course there was no way they could attack the animal in the midst of such a mob. Instead they used electronic boogiehorns to disperse the crowd by the power of sheer ugly noise and whipped up a bunch of buzz bombers and a little sealfield to cut Forty-second Street in half. The last I saw of the monster, it was slouching off in the direction of the old United Nations buildings with the guardsmen warily creeping along behind it. The crowd scattered, and I was left standing in front of Grand Central with a trembling, sobbing Elaine.

That was how it was all over the city on Crazy Sunday and on Monday and Tuesday, too. The behemoths were roaming from Harlem to Wall Street. Wherever they went they drew tremendous, crazy crowds that swarmed all over them without any regard for the danger. Some famous news photos came out of those days: three grinning black boys at Seventh and One Hundred Twenty-fifth hanging from the three purple rodlike things, the acrobats forming a human pyramid atop the Times Square beast; a little old Italian man in front of his house in Greenwich Village trying to hold a space monster at bay with just his garden hose.

There was never any accurate casualty count. Maybe five thousand people died, many trampled underfoot by the aliens or crushed in the crowd. Somewhere between three hundred fifty and four hundred human beings were gobbled by the aliens. Apparently that stoop and swallow thing is something they do when they're nervous. If there's anything edible within reach, they gulp it in. This soothes them. We made them very nervous, they did a lot of gulping.

Among the casualties was Tim, the second day of the violence. He went down valiantly in the defense of the Guggenheim Museum, which came under attack by five of the biggies. Its spiral shape held some ineffable appeal for them. We couldn't tell whether they wanted to worship it or mate with it or just knock it to pieces, but they kept on charging and charging, rushing up to it and slamming against it. Tim was trying to hold them off with nothing more than tear gas and boogiehorns when he was swallowed. The President had ordered the guardsmen not to use ethnic weapons. Maranta was bitter about that. "If only they had let them use grenades," she said. I tried to imagine what it was like, gulped down and digested in nifty tan uniform and all. A credit to his regiment. It was his atonement, I guess. He was back there in the Gary Cooper movie again, gladly paying the price for dereliction of duty.

Tuesday afternoon the rampage came to an unexpected end. The behemoths started keening over, and within a few hours they were all dead. Some said it was the heat—it was up in the nineties—and some said it was the excitement. A Rockefeller University biologist thought it was both those factors plus severe indigestion. They had eaten an average of ten humans apiece, which might have overloaded their systems. But as we later saw, indigestion couldn't have been the problem.

There was no chance for autopsies. Some enzyme in the huge bodies set to work immediately on death, dissolving

flesh and bone and skin and all into a sticky yellow mess. By nightfall nothing was left of them but some stains on the pavement, uptown and down. *A sad business,* I thought. Not even a skeleton for the museum, memento of this momentous time. The poor monsters. Was the only one who felt sorry for them? Quite possibly I was. I make no apologies.

At this time the other aliens, the little shimmery spooky ones, had stayed holed up in Central Park, preoccupied with their incomprehensible research. They didn't even seem to notice that their behemoths had strayed. But now they became agitated. For two or three days they bustled about like worried penguins, dismantling their instruments and packing them aboard their ship, then they took apart the other ship, the one that had carried the behemoths and loaded that aboard. Maybe they felt demoralized. As the Carthaginians who had invaded Rome did after their elephants had died.

On a sizzling June afternoon the alien ship took off. Not for its home world, at least not right away. It swooped into the sky and came down on Fire Island at Cherry Grove. The aliens took possession of the beach, set up instruments around their ship and even ventured onto the water, skimming and bobbing just above the surface like demented surfers. After five or six days they moved to one of the Hamptons and did the same thing, then to Martha's Vineyard. Maybe they just wanted a vacation. Then they left altogether.

"You've been having an affair with Maranta, haven't you?" Elaine asked me the day the aliens left.

I won't deny it.

That night you came in so late, with wine on your breath. You were with her, weren't you?

"No, I was with Tim. We sneaked into the park and looked at the aliens."

"Sure." Elaine said. She filed for divorce, and a year later I married Maranta. Very likely that would have happened sooner or later even if Earth hadn't been invaded by beings from space and Tim hadn't been devoured. But no question the invasion speeded things up a bit.

And now of course the invaders are back. Four years to the day from the first landing and there they were, pop whoosh ping thunk, Central Park again. Three ships this time, one of spooks, one of behemoths, and the third one carrying the prisoners of war. Who could ever forget that scene when the hatch opened and some three hundred fifty to four hundred human beings came out, marching like zombies? Along with the bison herd, half a dozen squirrels and three dogs. They hadn't been eaten and digested at all, just *collected* inside the behemoths and instantaneously transmitted somehow to the home world for study. Now they were being returned. "That's Tim, isn't it?" Maranta said, pointing to the screen. I nodded. Unmistakably Tim. With the stunned look of a man who has seen marvels beyond comprehension.

It's a month now and the government is still holding all the returnees for debriefing. No one is allowed to see them. The word is that a special law will be passed dealing with the problem of spouses of returnees who have entered into new marriages. Maranta says she'll stay with me no matter what, and I'm pretty sure that Tim will do the stiff-upper lip thing, no hard feelings if they ever get word to him in the debriefing camp about Maranta and me. As for the aliens, they're sitting tight in Central Park, occupying the whole place from Ninety-sixth to One Hundred Tenth and not telling us a thing. Now and then the behemoths wander down to the reservoir for a lively bit of wallowing, but they haven't gone beyond the park this time. I think a lot about Hannibal and about Carthage versus Rome and how the Second Punic War might have come out if Hannibal had had a chance to go home and get a new batch of elephants. Most likely Rome would have won the war anyway. But we aren't Romans, they aren't Carthaginians, and those aren't elephants in the Central Park reservoir. "This is such an interesting time to be alive," Maranta likes to say. "I'm certain they don't mean us any harm, aren't you?"

I love you for your optimism, I tell her then. And then we turn on the tube and watch the evening news. ∞

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STAR TECH

ACCESSING THE FUTURE

HICKS CLICK PIX

1988 marks the centennial of amateur photography, begun when George Eastman developed the first one-shot camera. Since those early days, photographic technology has come a long way, as evidenced by some of the latest products featured below.

ZOOM WITH A VIEW

This clever autofocus camera, the Olympus Infinity Superzoom 300, has a 38–105mm zoom lens able to capture both sweeping panoramas and tight close-ups. It bridges the gap between simple boxes and sophisticated single lens reflex cameras. List price: $600.

THROWAWAY SHOTS

Fuji's Quicksnap Flash has lens, film, and flash in a disposable box.

Finish the roll, take it to the camera store, and they'll develop your film— and toss the camera. List price: $13.95.

PHOTO-GRAPHICS

A vending machine for prints? Kodak's Create-a-Print lets you compose the perfect shot from any 35mm color negative. The finished product pops out in five minutes. List price for the machine: a mere $49,900.

THROUGH A LENS, AUTOMATICALLY

This is the latest version of the first professional-quality autofocus camera. The Minolta Maxxum 7000i has interchangeable lenses and computerlike electronic cards for special needs—including portraits. List price with 50mm normal lens: $838.

LOOK, NO FILM!

Is there a future for photography without celluloid and silver film? This alternative, Canon's Electronic Still Camera, uses floppy disks instead. List price for the normal lens: $899. List price for the Canon RC-760 body: $5,460.

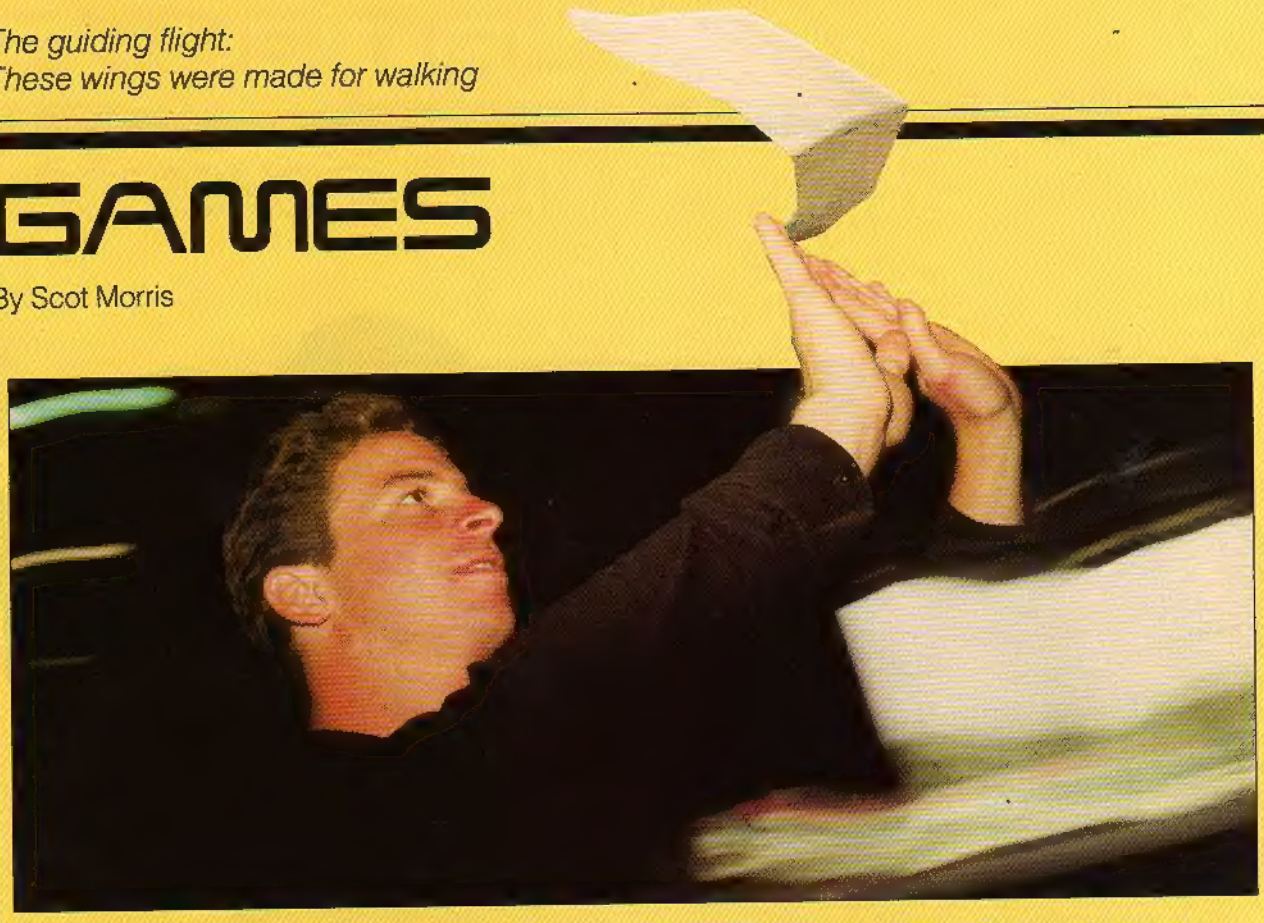
SOUL OF THE PHOTOGRAPHER

It looks like a video camera, but its shape hides a heart that's purely still photography. Yashica's Samurai can be operated one-handed because of its ergonomic design—and it takes half-frame pictures. That permits twice the number of shots on each roll of 35mm film. List price with case: $535.

The guiding flight:
These wings were made for walking

GAMES

By Scot Morris



About ten years ago, Tyler MacCready and his brother, Parker, were flying paper gliders. "We were testing their performance by seeing how high they hit the wall on the other side of the living room," Tyler MacCready says.

While attempting to outfly each other, the brothers realized that if they whooshed their hands under the planes, the craft would rise a few inches and hit the living room wall at a greater height. "So," MacCready adds, "we tried making wings that would fly very slowly, slow enough that we could walk along with them and whoosh them the whole way."

They began tinkering with the toy, trying versions made of balsa, tissue paper, and plaster foam. The shape that finally evolved resembled a 747's swept-back wing without the fuselage. The flight principle, of course, was nothing new, even then. Sea gulls and hang glider pilots use the so-called slope-soaring technique to fly along the edge of a cliff, getting their lift from the air forced upward by the slope. MacCready simply discovered a way to move the slope, using his own body to keep the wing under control.

Before long, he became so adept at keeping the plane aloft, he could actually fly it with no hands at all: By simply walking beneath the plane as it moved, he could make it glide on the air currents above his head. His Pasadena, California, neighbors grew accustomed to seeing the lanky teenager walking along, his hands behind his back and a balsa glider "head-soaring" a few inches above him.

On weekends, he'd help his father, Paul MacCready, who at the time was building the pedal-powered *Gossamer Condor* airplane (*Omni*, December 1978) at Shafter Airport in Bakersfield, California. In his spare time, the fifteen-year-old boy would experiment with his toy gliders in the airplane hangar or in the nearby windless desert.

Demonstrating a wing weighing one tenth of an ounce and made of the same polystyrene foam used in egg cartons, MacCready points out that it flies well only in the early dawn hours. During such times, the wind is virtually still and doesn't interfere with the gliding. Actually, he says, if you can feel the slightest breeze on your cheek or see leaves rustling, it's too windy to fly the wing outdoors.

The best place to fly MacCready's Walkalong Wing, in fact, is indoors, in as large an area as possible. Now an aerodynamics engineer, MacCready often flies the wing in a 15- by 30-foot work space at AeroVironment, the Simi Valley, California, aeronautics company founded by his dad.

As he walks through the large area, his body disturbs the air around him, sending currents up and over his head and shoulders. He can even direct the wing in a figure-eight pattern; and as he moves around the room, the eddies of air created in his wake cause the wing to "jump" as he retraces his steps.

The Walkalong Wing's top speed is only about four miles per hour. Unlike long, skinny paper airplanes that fly like darts, moreover, MacCready launches his plane by holding it with one hand above his head and walking forward. He then simply lets go and immediately moves his hands into position to start creating updrafts. Keeping his hands in a vertical position, he moves them toward

the center of the wing to pitch the nose up and slow the airspeed. The more he separates his hands, the more they concentrate the air, making the wing dive and speed up.

To make the wing turn to the left, for example, he moves his hands a little bit to the right. And for a sharp turn, he tilts his hands slightly to bank the plane downward on the side it's turning toward.

MacCready's longest flight so far has lasted about eight minutes. Aeronautics colleague and Walkalong Wing enthusiast Mike Waters, however, has claimed an unofficial flight record of 20 minutes by using a piece of cardboard to help create updrafts.

HEAD-SOARING GEAR

During a recent demonstration of the Walkalong Wing in a school gymnasium, the enthusiasm of onlookers was contagious. Word of the wing spread rapidly, and for days people inquired about it. Everyone, it seems, wanted to acquire or construct his own Walkalong Wing.

Although the Walkalong Wing has not been commercially available, MacCready has agreed to offer *Omni* readers a mail-order kit. Because it would be too difficult to mail the glider as a single unit, the kit comes with two precut, precreased wings made of polystyrene foam one-eighth-inch thick; all you have to do is tape them together and insert the included T-pin for weight. MacCready will also send an illustrated booklet with complete instructions for constructing and flying the wing, plus a sheet of cardboard to use as a whoosher, and an additional T-pin and sheet of uncut polystyrene to make a second wing. Send $5.95 plus $2 for postage and handling to Wing Kit, Tyler MacCready Enterprises, Box 3578, Simi Valley, CA 93063-3578.

Please note, however, that this Walkalong Wing won't have the high-priced look of a hobby-shop product. The polystyrene, which MacCready must cut himself using a hot-wire process, is purely functional and not as smoothly finished as the plastic in an egg carton or a disposable coffee cup.

Don't expect to put the Walkalong Wing together and immediately have fun. It will take a great deal of practice before you gain a sense of control over the glider. And you'll need a large indoor area—like a gym, tennis court, building lobby, or underground parking lot. If you try to fly it in the average living room, you'll be disappointed. Long hallways are good for learning to control a straight flight, which you'll want to do first anyway. Banking the wing through turns, however, requires a wider area.

When you break the 20-minute flight record or succeed in making a loop and regaining control afterward, let us know.

THE POWER OF TEN

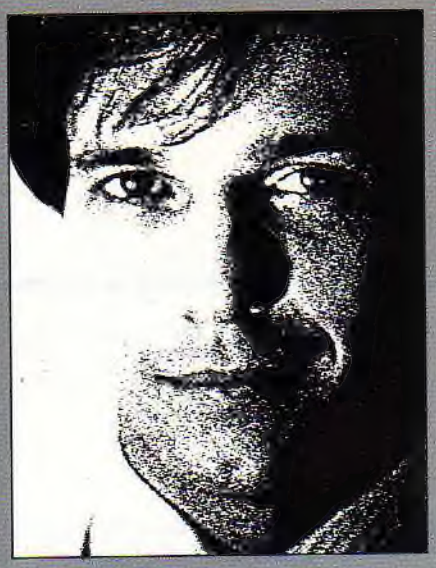
In homage to our tenth anniversary, we wanted to report on the number 10. We asked numbers expert Martin Gardner if there was anything unusual in his files. "Ten seems to be a dull number," he finally told us, and decided to experiment with the word *ten* instead. What would happen, he wondered, if he shifted each letter forward?

First he moved them one space to the next letter. To his surprise, the letters *T, E,* and *N* corresponded to the letters *U, F,* and *O*. No other shift, moreover, produced anything particularly significant. Is the connection between *10* and *UFO,* we wondered, a mere coincidence? Or a portent of things to come in the next year? Stay tuned in.

In mathematics, *10* is a triangular number, modeled by the arrangement of tenpin bowling. It's also tetrahedral—as in a stack of cannonballs with six on the bottom layer, three in the middle, and one on top. And of course, it's the basis of our counting system—probably because, through evolutionary developments, we became a ten-fingered, ten-toed species. (Our ancestors surely must have run into some difficulties when they ran out of fingers and toes to count.)

Somewhere along the line, the number 10 seemed significant to more than a few people: There were the ten plagues of Egypt in the Bible, the Ten Commandments, the ten articles in the Bill of Rights, the children's song "Ten Little Indians," and, of course, the ten-gallon hat.

There's also an interesting bit of trivia concerning 10 Downing Street, the British prime minister's London residence: The front door can be opened only from the inside.



LAST WORD

By Terry Runté

"The new ceramic superconductor is astounding but has a problem: It comes in only one color—a repellent avocado, similar to the color used on appliances found in early-Seventies kitchens."

It all started in 1911, when Dutch physicist Heike Kamerlingh Onnes conducted experiments by immersing various materials in liquid helium to view their behavior at extremely low temperatures. Some results were predictable: Ice cream, for example, became all but impossible to serve, even with a wet scoop, and one of the lab assistants would always lick the scoop and have to be rushed to the hospital. Onnes also discovered that when certain metals are cooled to within a few degrees of absolute zero, they lose all resistance to the flow of electrical current. He called this new phenomenon superconductivity.

With superconductors you could create incredibly powerful magnetic fields upon which objects could "magically" float. Onnes envisioned a world in which people could travel across huge expanses of land on sleek, levitated horses, reaching speeds exceeding 300 miles per hour.

Onnes's vision had one serious drawback—immersing the horses in liquid helium was prohibitively expensive and killed the stupid beasts instantly. He tried breeding hardier horses with heavy coats of fur to withstand the -460° temperature at which all molecular motion stops but had little success. He even toyed with the concept of motorized, frozen horses.

In the end, Heike Kamerlingh Onnes became a bitter eccentric, roaming taverns with a bar of lead and a jug of liquid helium, playing cruel jokes on drunken longshoremen. One night in a Philadelphia bar he made the mistake of challenging Thomas Alva Edison to arm-wrestle. Edison electrocuted him with a powerful hand buzzer. Yet research continued as physicists looked for superconductors that would work at higher temperatures. It was a long shot at best, but they somehow knew that a room-temperature superconductor would have applications in space travel, nuclear power, and the refrigerator-magnet industry.

In the following decades research dragged on, with most physicists agreeing that superconductor technology was a dead end. Then, on a December day in 1967, *Life* magazine received a phone call from a small campus laboratory in California. The connection was weak, and there was obviously a party going on in the background. No wonder—the young physics student was describing the superconductor scientists had long awaited.

"It's superconducting, man," the young physicist confided. "We can all feel it giving off this aura. It's like a trillion degrees in here. Oh, wow, now Suzy is superconducting. Hell, she's starting to melt! Damn it, everyone is melting. Shit, man, I gotta go. . . ."

After an extensive Congressional investigation, LSD was banned.

Scientists found materials that superconducted at up to 23° Kelvin, but that temperature was still unbearably cold. For example, if you were to chill just a single ounce of aluminum to 23° Kelvin and then drop it down a man's shorts, he'd hop around and curse for 47 full days. We're talking cold.

The vital breakthrough in superconductors came on the set of *Ferris Bueller's Day Off*, an unremarkable teen comedy distinguished solely by the physics wizardry of its star, Matthew Broderick.

"I was in my trailer, playing around with various ratios of barium, oxygen, and copper," says Broderick, "when in comes Mia Sara wearing a new charm bracelet. It was pure yttrium. I nabbed it, mixed it with the other elements, and created a bitchen ceramic oxide compound that superconducts at ninety-five degrees K."

Though Broderick's new ceramic superconductor is astounding, physicists agree there are problems with its practical use. It comes in only one color—a repellent shade of avocado, similar to the one used on Sears' appliances in the early Seventies. And at high current levels it emits a shrill chirping and smells like ambergris—an exotic, waxy whale secretion used by the perfume industry. Unrefined ambergris frankly smells a lot like shit. The science community is faced with a horrendous aesthetic dilemma.

While Broderick toiled on the set of the monkey film *Project X*, Emilio Estevez, Charlie Sheen's brother (Emilio uses the last name Estevez because he thinks *Emilio Sheen* sounds like a Hispanic hair-care product), surged ahead with his long-standing research into ceramic oxide.

"Trace elements are the key," says Estevez. "I added zinc and lowered the barium–yttrium ratio. That got rid of the rank smell and lowered the chirping to the point where it was sort of soothing. But it's still a real puky green."

The greatest minds in physics were stumped—Tom Cruise, John Cusack, and Rob Lowe all tried and failed. Even C. Thomas Howell was at a loss. But Estevez found a solution.

"We'll just get all our trendy actress girlfriends to wear avocado green in their next few movies," he announced to a conference room filled with eager reporters. "Demi Moore has already agreed. Once people see her in a superconductor-colored bikini, it'll be the hottest hue on Earth."

As the conference broke up, the reporters dashed to the nearest clothing stores in search of avocado-green ties and socks. Once again science had triumphed over fashion.

Terry Runté of the Chicago writers' brat pack emits a chirping under heavy pressure and frankly smells a lot like ambergris.